Black Hills National Forest
Northern Hills Ranger District
Spearfish, South Dakota

Englewood Springs Botanical Area Management Strategy January 2011

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Date: 13 JAN 2011

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Date: 1/13/11

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1 Purpose of this Management Strategy

This strategy has two main purposes: 1) identify the botanical values for which Englewood Springs Botanical Area (ESBA) was designated, and 2) provide a comprehensive set of recommendations to further our understanding of the botanical resources contained within ESBA and to ensure that the area continues to sustain botanical values into the future. It will serve as a guide for future development of management actions for the area.

This strategy was developed in collaboration with an interdisciplinary team of Northern Hills Ranger District personnel and the Black Hills National Forest Botanist. Identification of botanical values was also based on information provided by a focus group of local botanical experts and the South Dakota Natural Heritage Program. Their participation in providing valuable information is gratefully acknowledged.

This strategy is a work in progress. It is a plan that will be dynamic; recommendations may change over time depending on monitoring results, information from additional scientific studies, or changes in the environment.

2 Location and Surrounding Land Management

ESBA is located south of Lead, South Dakota within the Black Hills National Forest and Lawrence County (Figure 1). The designated area is 164 acres. It is situated within T4N R3E S29, with a small portion extending south into the northern ¼ of T4N R3E S32. ESBA is surrounded by National Forest System lands designated as Management Area 5.1-Resource Production Emphasis. Several private parcels are adjacent or near the ESBA boundary. ESBA is located within the Upper Elk Creek grazing allotment. Forest System Roads 228.1, 228.1A, and 707.1 run through the botanical area (Figure 2). These roads are closed to public use per the Black Hills National Forest Travel Management Plan effective December 1, 2010.

The ESBA boundary encompasses a forested northwest-facing hillside, a narrow valley with a grassy meadow, numerous springs and seeps, and an unnamed tributary to Whitewood Creek. These features are discussed in detail throughout this document.

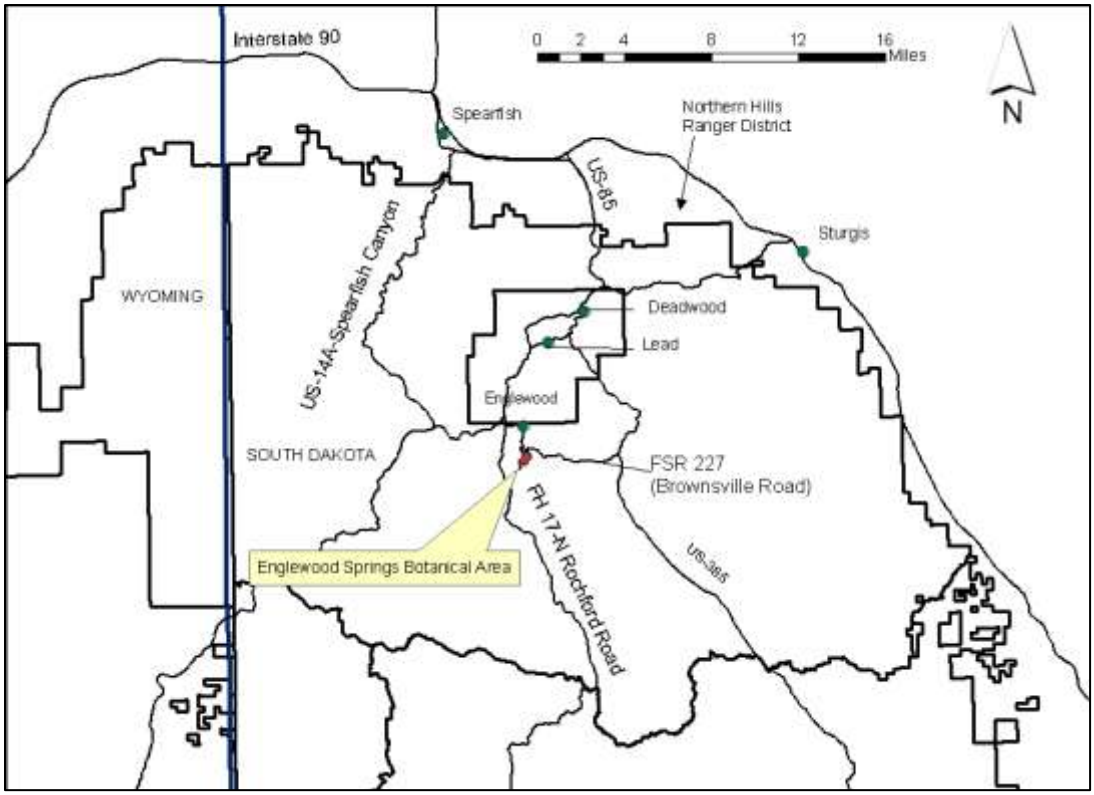

Figure 1. Area map of Englewood Springs Botanical Area.

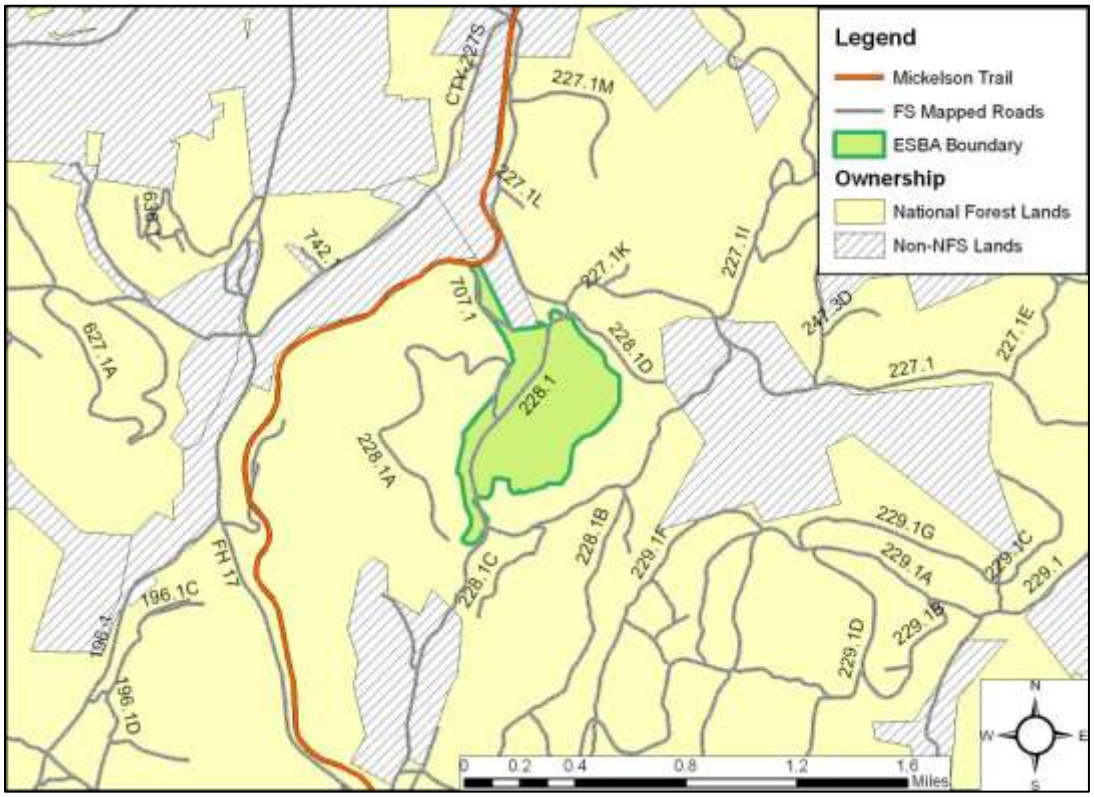

Figure 2. Area map showing ESBA, existing roads, and lands ownership. Not all roads shown are open to public use per the Black Hills National Forest Travel Management Plan.

3 Applicable Regulations and Forest Plan Direction

ESBA was designated a botanical area in the 1997 Black Hills National Forest Revised Land and Resource Management Plan (1997 Forest Plan) (USDA Forest Service 1997). The 1997 Forest Plan and subsequent Phase II Amendment (USDA Forest Service 2006) provided general management area direction and allowed for the development of specific botanical area management strategy. Drawing on the Forest Plan direction for botanical areas, this management strategy seeks to describe the botanical and other special interest values present at ESBA and elaborate appropriate management strategies specific to the area.

ESBA was established as a botanical area in accordance with Forest Service Manual (FSM) 2372 (Special Recreation Designations-Areas Designated Administratively). FSM 2372.05 defines a botanical area as "a unit of land that contains plant specimens, plant groups, or plant communities that are significant because of their form, color, occurrence, habitat, location, life history, arrangement, ecology, rarity, or other features." FSM 2372.4 also provides directives regarding development, occupancy, and public use of botanical areas. Among these directives are limitations on recreational facilities and developments such as roads and trails to allow public enjoyment while protecting the special features of the area.

The 2006 Phase II Amendment to the 1997 Forest Plan (Forest Plan) contains the current management area direction for botanical areas (USDA Forest Service 2006). The overall management of botanical areas is guided by Management Area 3.1-Botanical Areas, which emphasizes management to protect and enhance botanical values. Numerous other standards, guidelines, goals, and objectives within the Forest Plan regarding sensitive plants, habitat diversity, fuels, noxious weeds, livestock, and other areas are relevant to ESBA. A compilation of relevant Forest Plan direction is included in Appendix A.

4 Designation History

ESBA has been an area of botanical interest for over 40 years. Some of the site's botanical values were first documented in 1967. At that time, Myrtle Kravig, a local botanist and orchid expert, made the first collection of *Listera convallarioides* (broad-lipped twayblade) in South Dakota and in the late 1960s documented a number of other orchid species found at ESBA (Kravig 1969). Kravig's discovery stood as the only known occurrence of *Listera convallarioides* in South Dakota and the Black Hills until 1992. (There are currently four known populations of *Listera convallarioides* in the Black Hills.)

In the early 1980s, Mrs. Kravig contacted botany professor Joe Thomasson as she became concerned for the conservation of the site. Upon learning that a timber sale was planned in the area, Dr. Thomasson worked with foresters to ensure the springs and rare plant community would be protected from logging.

South Dakota Natural Heritage Program (SDNHP) Botanist Dave Ode documented the hillside springs and rare plant community in 1983. In 1984 the area was recommended for designation as a National Forest Special Interest Area (SIA) by the South Dakota Department of Game, Fish, and Parks.

In 1993, the Nature Conservancy recommended Englewood Springs as an area for special protection in the upcoming Forest Plan revision. In 1997 that recommendation was enacted in the revised Forest Plan, and Englewood Springs Botanical Area was established. At that time the boundaries and general Forest Plan direction were also set. No detailed establishment study or documentation of values related to the area's designation was prepared.

5 Site Description

ESBA is located within the geomorphic central core of the Black Hills and represents the Northern Coniferous Forest Complex characteristic of the Black Hills region (Froiland 1978). Botanical features include numerous rare plant populations, notable plant species diversity, and forest types endemic to the Black Hills. Other values important to the area include numerous springs and cold water streams, wildlife habitat, and the area's overall ecological significance. These values are described in detail in the "Botanical Values" portion of this document.

5.1 Historic and Current Land Uses

The botanical area is named for the nearby historic town of Englewood, reflecting a long history of human uses in the area. ESBA is approximately 1.5 air miles south of the original town site. It was known as a stage stop along the way to Deadwood, then experienced a boom in the 1890s when standard gauge and narrow gauge railroad lines converged there. A round house was established to serve the large engines. There was also a generating plant and post office. The post office closed in 1943 (Parker and Lambert 1974, Raisch 2006). There are now several private homes and a trailhead for the Mickelson Trail near the townsite.

Forest Road 228.1, which bisects the botanical area, is known locally as Ice Box Cave Road. Ice Box Cave is an old mine adit just south of the botanical area along the road. Scattered prospect pits indicate that past mining activity occurred in the area. Livestock grazing, logging, and hay production are also known to have occurred in the area since federal designation of the Black Hills Forest Reserve in 1897.

Past forest management actions in the area include the Englewood Timber Sale in 1980 and the Woodville Timber Sale in 1993. Current logging in the area surrounding ESBA includes the Hanna and Corral timber sales. Prescribed burning to the south and east of the botanical area is authorized under the 2009 Telegraph Project Area Environmental Impact Statement and may take place in the future.

The area was part of the Bear Butte grazing allotment until it was divided in 1980 and the portion of the allotment that includes ESBA became the Upper Elk Creek allotment. Currently, the stocking rate on the Upper Elk Creek allotment is 336 animal unit months (AUMs). The botanical area is not currently fenced and livestock have access to the area. The meadow in the valley bottom within ESBA is designated a primary grazing area. On adjacent private lands north of ESBA, meadows are currently used for hay production.

Recreational activities in the vicinity of ESBA include the non-motorized Mickelson Trail on the old railroad grade. A short segment of the Mickelson Trail passes next to the ESBA boundary on the

northwestern side (Figure 2, above). Motorized recreation with ATVs predominating occurs on various routes in the area.

5.2 Climate

ESBA is located in the northern portion of the Black Hills, which is relatively cool and moist compared to the surrounding prairie and drier southern Black Hills. Climate data are available from the Lead weather station, located about 5.5 miles north of ESBA (Figure 3).

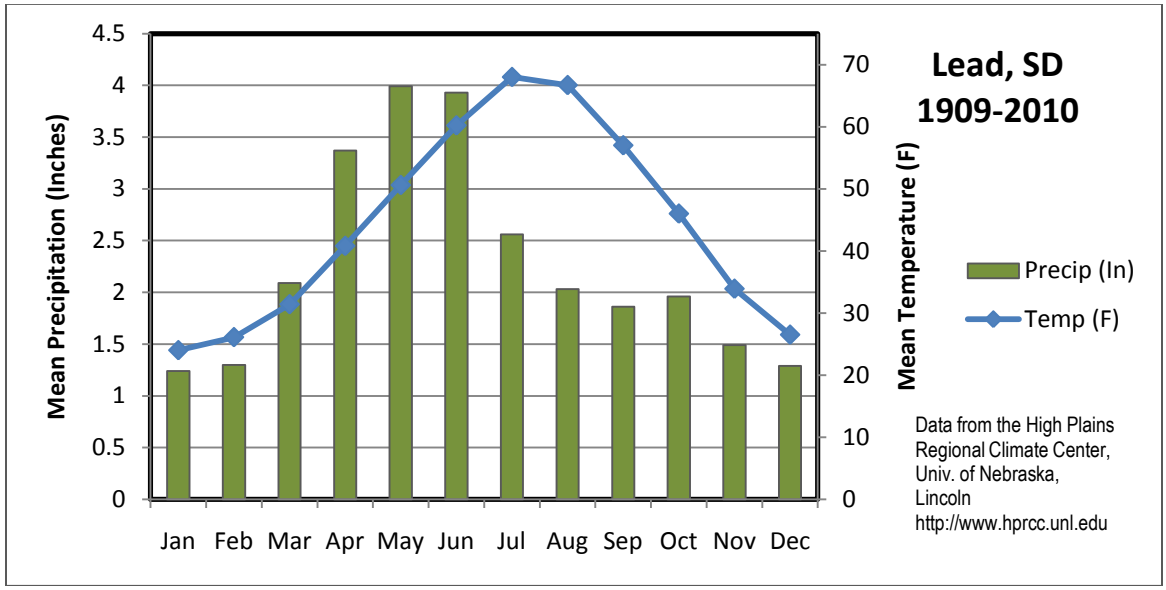

Figure 3. Climate diagram for Lead, SD.

The average annual daily maximum temperature in Lead is about 55° F, and July, the warmest month, has an average maximum temperature of 80° F. The average daily minimum temperature is 34° F, and January is the coldest month with an average daily minimum of 14° F with lows below -15° F.

The average annual precipitation in Lead is about 27 inches, and most precipitation falls as rain during the warmer part of the year and is normally heaviest in late spring and early summer. In winter annual seasonal snowfall is 145 inches, and winter snowfalls are frequent with most snow falling in March and April.

5.3 Geology

The geology of ESBA is comprised of sedimentary rocks (Figure 4). Intrusive rocks lie north of the botanical area boundary in a formation of rhyolite porphyry that corresponds to the Woodville Hills area. There are several mining prospect pits within this geologic layer. The meadow within ESBA is mapped as Quaternary alluvium. The majority of ESBA occurs on Deadwood Formation, which consists of shale, sandstone, and limestone. There is an unconformity between the Quaternary alluvium and the Deadwood Formation. There are past mining prospect pits within this formation. Upper slopes of the botanical area contain thin layers of undifferentiated Whitewood Limestone-Winnepeg Formation, and Englewood Limestone. The Winnepeg Formation is a less permeable layer consisting of shale, siltstone, and sandstone. These two thin layers are capped by Pahasapa Limestone (also known as

Madison Formation). The Pahasapa Limestone is the upper geological layer where most of the ground water recharge from precipitation occurs. A syncline arcs across the landscape south of ESBA (Redden, Lisenbee, and Fahrenbach 2010).

The relation of the underlying geology to groundwater resources is discussed in the "Hydrologic Resources" section of this document.

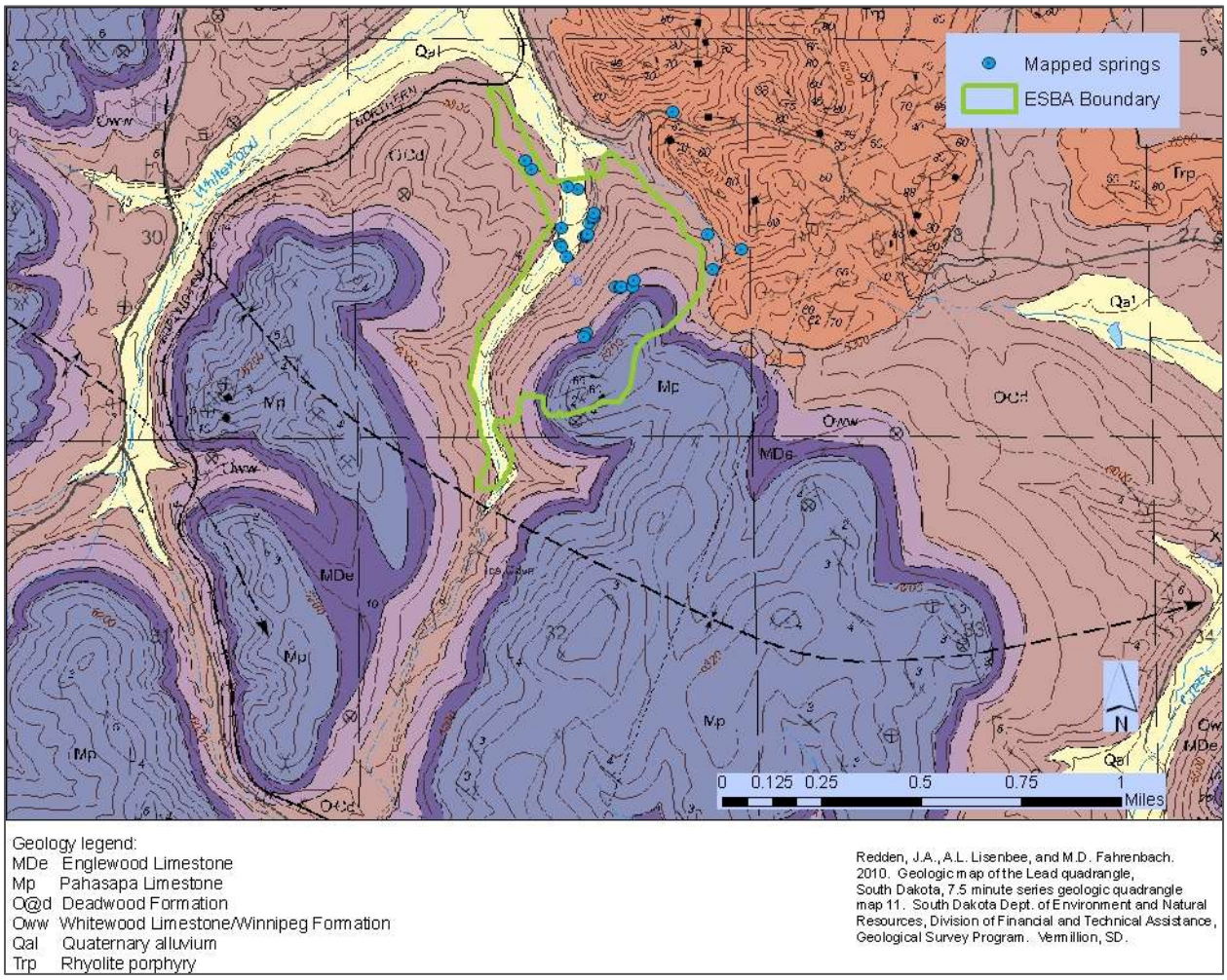

Figure 4. Geologic map of ESBA and vicinity showing mapped springs.

5.4 Soils

The soils of ESBA can be grouped into two general soil/geomorphic units: 1) soils on side slopes and ridge tops, and 2) soils along the valley bottom and along springs and seeps. The dominant soils of slopes and ridges are Citadel, Grizzly and Virkula soils. These soils are deep, well drained and formed in material weathered from calcareous sandstone, limestone, and soft shale. They are generally loamy and in places have a high rock content of gravel and cobbles. The available water holding capacity is moderate or high, permeability is moderately slow, and runoff is medium to rapid (USDA, SCS 1979, Trillium Botanical and Ecological Services 2010).

Soils along the perennial stream and valley bottom are Marshdale and Maitland soils. These soils are deep, poorly drained along the stream and well drained on terraces, and formed in alluvium and in material weathered from sandstone, limestone and shale. The Marshdale soil occurs in the lower part of the landscape along the drainage, and the Maitland soil occurs higher in the landscape. The soils are generally loamy, the available water holding capacity is high, permeability is moderately slow or moderate, organic matter content is medium to high, and runoff is medium (USDA, SCS 1979, Trillium Botanical and Ecological Services 2010).

Springs and seeps occur on the northwest facing hillside, in the grassy meadow, and on the toeslope at the north end of the botanical area. The springs flow into the unnamed tributary to Whitewood Creek, while the flow of some of the seeps only saturates soils in localized areas. These soils were not separated in the county soil survey, but they are hydric soils, are saturated for a significant portion of the growing season, have a high organic matter content, and support hydrophytic vegetation. Some soils on the wet toeslope to the north, may contain a histic epipedon, which is an organic layer at least 8 inches thick and forms under saturated conditions (Trillium Botanical and Ecological Services 2010).

6 Botanical Values

ESBA encompasses a small area but a significant array of botanical features. These features include populations of rare plant species, diverse plant assemblages, and regionally endemic vegetation types. These botanical features are dependent on several key environmental and biotic attributes of the area, which must also be considered as fundamental to botanical values. Other botanical values, such as the area's contribution to regional biological diversity, are derived from the site's context and individual components. These derived botanical values are no less important and may be more enduring than any one botanical component of the site. Furthermore, the biotic and abiotic components at ESBA likely act synergistically to create a community that is more than the sum of its parts.

6.1 Uncommon Habitats and Vegetation Types

ESBA includes several distinct vegetation types (Table 1). These vegetation types vary in their contribution to botanical values based on distribution of known rare plant occurrences, significance as rare plant habitat, quality of native vegetation, plant species diversity, and supporting hydrologic features. Based on these different qualities, habitats are defined as primary or secondary. Primary botanical habitats are identified as the springhead habitat, white spruce alluvial forest in the valley bottom, and white spruce/twinflower forest along the northwest facing slope (Figure 5). These three habitats represent plant communities not found outside of the Black Hills region, thus their conservation at ESBA contributes to their preservation at a global scale. These community types serve as rare plant habitat, wildlife habitat, and form the ecological backbone of ESBA.

Table 1. Summary of botanical habitats within ESBA.

Name/vegetation type	Botanical value	Acres	Rare plant populations known
Springhead	Primary	1	• *Listera convallarioides* (broad-lipped twayblade) • *Cypripedium parviflorum* (lesser yellow lady's slipper) • *Carex capillaris* (hair-like sedge) • *Carex leptalea* (bristly-stalked sedge) • *Corallorhiza trifida* (yellow coral root) • *Platanthera dilatata* (scentbottle) • *Orobanche uniflora* (one-flowered broomrape)
White spruce/twinflower forest	Primary	75	• *Calypso bulbosa* var. *americana* (fairy slipper) • *Carex leptalea* (bristly-stalked sedge) • *Carex capillaris* (hair-like sedge) • *Cypripedium parviflorum* (lesser yellow lady's slipper) • *Listera convallarioides* (broad-lipped twayblade) • *Orobanche uniflora* (one-flowered broomrape) • *Vaccinium membranaceum* (mountain huckleberry)
White spruce alluvial Black Hills forest	Primary	15	• *Carex capillaris* (hair-like sedge) • *Carex leptalea* (bristly-stalked sedge) • *Listera convallarioides* (broad-lipped twayblade) • *Astragalus americanus* (American milkvetch) • *Cypripedium parviflorum* (lesser yellow lady's slipper) • *Moneses uniflora* (single delight)
Grass meadow	Secondary	16	None known
Ponderosa pine forest	Secondary	57	None known

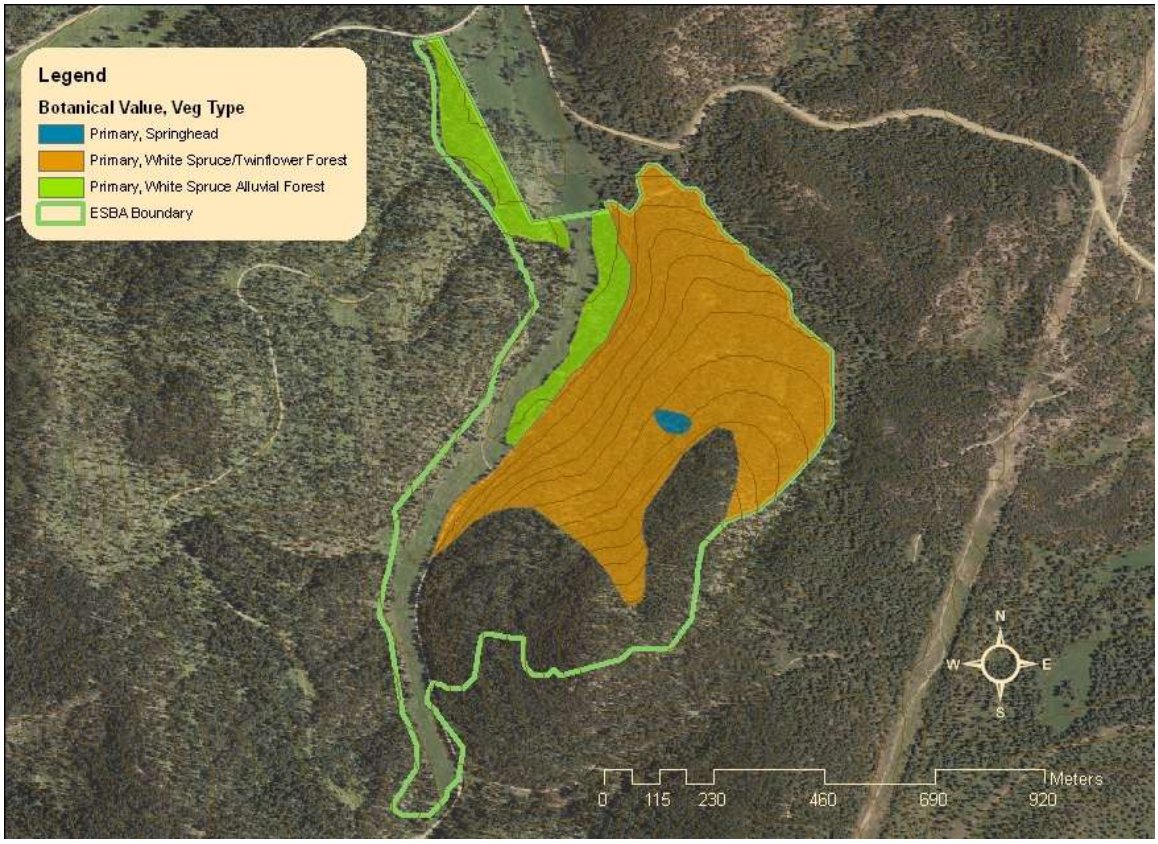

Figure 5. Botanically important community types (shown as colored areas) within designated ESBA boundary.

6.1.1 Springhead Habitat

A series of hillslope springs emerge from the northwest-facing hillside about halfway up the slope between the valley bottom to the west and the rocky ridgetop to the east. There are five or more closely spaced locations traversing a north-south axis where waters discharge. The hillside is heavily forested but there is a small forest opening at southernmost of the discharge points (Photo 1).

The small forest opening supports several rare plant populations, including *Listera convallarioides* (broad-lipped twayblade), *Cypripedium parviflorum* (lesser yellow lady's slipper), *Carex capillaris* (hair-like sedge), *Carex leptalea* (bristly-stalked sedge), *Corallorhiza trifida* (yellow coral root), *Platanthera dilatata* (scentbottle), and *Orobanche uniflora* (one-flowered broomrape). All of these rare plants have also been found within ESBA outside of the small forest opening at the springhead, but this area supports the main *Listera convallarioides* population. The forest opening has *Rudbeckia laciniata* (cutleaf coneflower), *Heracleum maximum* (common cowparsnip), *Thalictrum dasycarpum* (meadow rue), *Circaea alpina* (small enchanter's nightshade), *Equisetum arvense* (field horsetail) and other plants with relatively high moisture requirements.

Combinations of emerging springs, seeping water, and flowing spring brooks create innumerable microhabitats of varying moisture levels, flow rates, moss cover, soil organic matter, and associated plant cover. A thick cover of moss is present where soils are saturated near areas of seeping and flowing water, while slightly drier areas are generally dominated by *Phleum pratense* (timothy), an

exotic rhizomatous grass, as well as the native grass *Calamagrostis canadensis* (bluejoint or Canadian reedgrass). The springhead forest opening is also heavily invaded by noxious weeds, including *Cirsium arvense* (Canada thistle), *Cirsium vulgare* (bull thistle), *Cynoglossum officinale* (houndstongue), and *Leucanthemum vulgare* (oxeye daisy).

Photo 1. The springhead forest opening in early spring.

The springhead forest opening is difficult to classify; it does not appear to match any description in the Black Hills Community Inventory (Marriott & Faber-Langendoen 2000). It may be too small to support an identifiable community type or may be undescribed. It is not known what factors maintain the small opening; there is little tree regeneration inside the opening presently. A few large, decadent *Populus tremuloides* (aspen) trees are present within the glade. There are also old stumps within the opening as well as several old mining pits adjacent to it. It is possible the opening is the result of historic mining activity. Understanding the ecological characteristics and processes of this habitat would facilitate appropriate management and contribute to its preservation.

The springhead forest opening supports the largest concentrations of *Listera convallarioides* plants within ESBA. The unique attributes of the habitat likely underlie its function as primary rare plant habitat, including relatively open light conditions, its protected location within the surrounding dense forest stands, high moisture levels from both seeping and running spring water, calcareous substrates, high moss cover, landscape position (slope and aspect), and diversity of microhabitats.

6.1.2 *Picea glauca* (White Spruce) Alluvial Black Hills Forest

The spring brooks travel down the forested hillside and merge in the valley bottom forming a small tributary to Whitewood Creek. Several springs also discharge at the toe of the slope and flow briefly to join the tributary. This stream in the valley bottom supports a small but high quality example of white spruce alluvial Black Hills forest (Figure 5, above; Photo 2). A small area of white spruce alluvial Black Hills forest is also present in the northwest arm of ESBA (approximately 8 acres). This regionally endemic forest type is restricted to higher elevations in the central core and limestone plateau areas of the Black Hills (Marriott & Faber-Langendoen 2000). It is ranked G2/G3 (imperiled to vulnerable) by NatureServe, the international network of natural heritage programs and conservation data centers, signifying it is of conservation concern (NatureServe 2009).

The alluvial forest in the valley bottom supports rare plant populations of *Carex capillaris, Carex leptalea, Listera convallarioides*, *Astragalus americanus* (American milkvetch)*, Cypripedium parviflorum*, and *Moneses uniflora* (single delight). Other plants characteristic of this area include *Carex utriculata* (Northwest Territory sedge)*, Glyceria striata* (fowl mannagrass)*, Calamagrostis canadensis* (bluejoint/Canadian reedgrass)*, Aconitum columbianum* (Columbian monkshood)*,* and *Actaea rubra* (red baneberry). The overstory is dominated by white spruce but aspen and *Betula papyrifera* (paper birch) are also important components. The shrub layer is fairly open and diverse, with *Sambucus racemosa* (red elderberry)*, Salix bebbiana* (Bebb willow), and *Cornus sericea* ssp. *sericea* (redosier dogwood) as components.

Photo 2. White spruce alluvial forest with mossy stream banks and small stream.

The alluvial forest in the northwest arm of ESBA supports populations of *Carex leptalea* and *Carex capillaris*. This area is also potential habitat for other rare plants. While the same vegetation type, the flora and hydrology of the northwest arm differs slightly from the valley bottom stream. Water flows from several indistinct seeps along a low gradient, creating a small wetland community with a white spruce overstory. Aspen are scattered in the canopy as well. The spring waters flow among the white

spruce roots, creating small pools, spring brooks, and saturated areas that are interspersed with mossy hummocks. The herb layer is dominated by graminoids, including the two rare sedges, other wetland sedge species, and *Calamagrostis canadensis* (bluejoint/Canadian reedgrass). The dominance by graminoids appears to hold forb and woody plant diversity somewhat in check, as the wetland may not be as species rich as the valley bottom stream forest. Mosses are abundant on hummocks and tree roots and are an important component of the habitat.

Photo 3. White spruce alluvial Black Hills forest with graminoid dominated wetland understory in the northwestern portion of ESBA.

Several attributes of the alluvial forests likely contribute to their function as habitat supporting high species diversity and rare plant populations. Among these are shade and protection provided by the white spruce and deciduous trees, perennial flows of cool, high quality spring water, calcareous substrates, deep, moist soils, small scale disturbance from frequent falling of white spruce and resulting configurations of deadfall, its landscape position in the valley bottom and likely cool air drainage, and overall riparian health.

6.1.3 *Picea glauca/Linnaea borealis* (White Spruce/Twinflower) Forest

The majority of the area within ESBA is dominated by white spruce or a mix of white spruce and *Pinus ponderosa* var. *scopulorum* (ponderosa pine) (Figure 5, above). Portions of the white spruce forest outside of the immediate water influence zone of the hillside spring brooks appear to be in a mid-seral stage, with an overstory of ponderosa pine with thick regeneration of white spruce in the midstory

(Photo 4). There are old white spruce and ponderosa pine stumps throughout the stand. The lower slope forest canopy is dominated by white spruce. The proportion of ponderosa pine in this vegetation type increases up slope and away from the additional moisture of the springs.

The understory contains many plants indicative of cool, moist conditions, including *Oryzopsis asperifolia* (roughleaf ricegrass)*, Chimaphila umbellata* (pipsissewa)*, Cornus canadensis* (bunchberry dogwood)*, Osmorhiza longistylis* (longstyle sweetroot)*, Orthilia secunda* (sidebells wintergreen)*, Linnaea borealis* (twinflower)*,* and *Vaccinium scoparium* (grouse whortleberry). Shrub species include *Juniperus communis* (common juniper)*, Shepherdia canadensis* (russet buffaloberry)*,* and *Arctostaphylos uva-ursi* (kinnikinnick). The forest may be classified as white spruce/grouse whortleberry (*Picea glauca/Vaccinium scoparium*), but is probably best described as a white spruce/twinflower (*Picea glauca/Linnaea borealis*) community type. This forest type is endemic to the Black Hills and is ranked G2/G3 (imperiled to vulnerable), signifying it is of conservation concern. This forest type is generally found on northwest to northeast facing slopes with loamy soils at an elevation range between 5,700 to 6,400 feet (Marriott & Faber-Langendoen 2000).

Photo 4. Transitional forest stand in ESBA showing ponderosa pine canopy and white spruce regeneration.

Within ESBA, white spruce/twinflower habitat supports known rare plant populations, including *Calypso bulbosa* var. *americana* (fairy slipper), *Carex leptalea, Carex capillaris, Cypripedium parviflorum*, *Listera convallarioides*, *Orobanche uniflora* and *Vaccinium membranaceum* (mountain

huckleberry) and contains potential habitat for other rare plants. The forest is important habitat for the rich diversity of both common and rare orchid species found within ESBA. The forest is also an essential part of the mycorrhizal relationships upon which many species depend. The white spruce/twinflower forest forms the fabric or matrix that supports many of the botanical values found within ESBA. Furthermore, as an endemic forest type of conservation concern, the white spruce/twinflower forest is a botanical resource that contributes significantly to the values preserved within ESBA.
The spring brooks that cascade down the forested hillside are of particular botanical importance. Many rare plant populations are arrayed along the spring brooks. In places, the banks of these spring brooks are comprised of saturated, loose, calcareous soil held together by mosses. These banks are very fragile.

A small pocket of aspen approximately seven acres in size is found in the northeastern portion of ESBA along the northern aspect below the ridgetop. The understory within the aspen pocket is dominated by graminoids, including *Leymus innovatus* (fuzzyspike wildrye) and *Phleum pratense.* This area does not support any known rare plant populations. Generally, aspen stands do not comprise important rare or sensitive plant habitats in the Black Hills. As such, the main botanical value of the aspen inclusion is its contribution to plant and habitat diversity within ESBA. Young white spruce and ponderosa pine trees are present throughout the aspen inclusion.

Relatively little is known about the ecology and natural disturbance regimes of Black Hills white spruce forests. Some of the rare plants are associated with climax conditions and lack of landscape level disturbance such as wildfire. Others may benefit from small scale (such as small canopy openings from scattered tree mortality) or large scale moderate disturbance. Fungal populations are probably likewise dynamic, but well-developed mycorrhizal associations are generally associated with lack of disturbance of forest soils and host availability (in this case, white spruce and ponderosa pine trees). While much of the white spruce/twinflower forest appears to be in transition from ponderosa pine to white spruce overstory, many of the rare plant species present are typically associated with mature white spruce forests. This suggests the current trend could benefit most rare plant populations occurring within the habitat. More information on the ecology and dynamics of the white spruce/twinflower forest would contribute to appropriate management of botanical resources in this habitat type.

6.2 Secondary Habitats

Certain areas within ESBA are not known to hold any special botanical resources such as rare plant populations or habitats. These areas function primarily as buffers against surrounding land uses and management activities which may be incompatible with ESBA.

6.2.1 Grass Meadow

The meadow area is approximately 20 acres (Figure 6). It consists primarily of exotic grasses *Phleum pratense*, *Poa pratensis* (Kentucky bluegrass), and *Bromus inermis* (smooth brome). The meadow is devoid of riparian woody vegetation (such as willow; although there is a solitary white spruce tree and elderberry bush at the lower end of the meadow) and is heavily infested with *Cirsium arvense*. There is an area of wet meadow vegetation at the lower end of the meadow near the northern botanical area

boundary that includes plants such as *Carex utriculata* (Northwest Territory sedge) and *Scirpus microcarpus* (panicled bulrush) that indicate sustained saturated conditions.

The meadow area has the potential to contribute to botanical values in three ways. First, there are several springs that contribute high quality water to the main stream channel in the alluvial forest, thereby connecting it hydrologically to an area of primary botanical value. However, flow regimes of the meadow springs (and thus their overall contribution of water to botanical habitats) are not well understood. Second, the area may act as a buffer to the white spruce alluvial forest. However, other than existing as a narrow land area between managed pine stands on the western side of the drainage and the alluvial forest to the east, the meadow's function as a buffer is unclear. Finally, the meadow connects the primary botanical habitats to the east with the small lobe of white spruce alluvial forest on the western side of the valley.

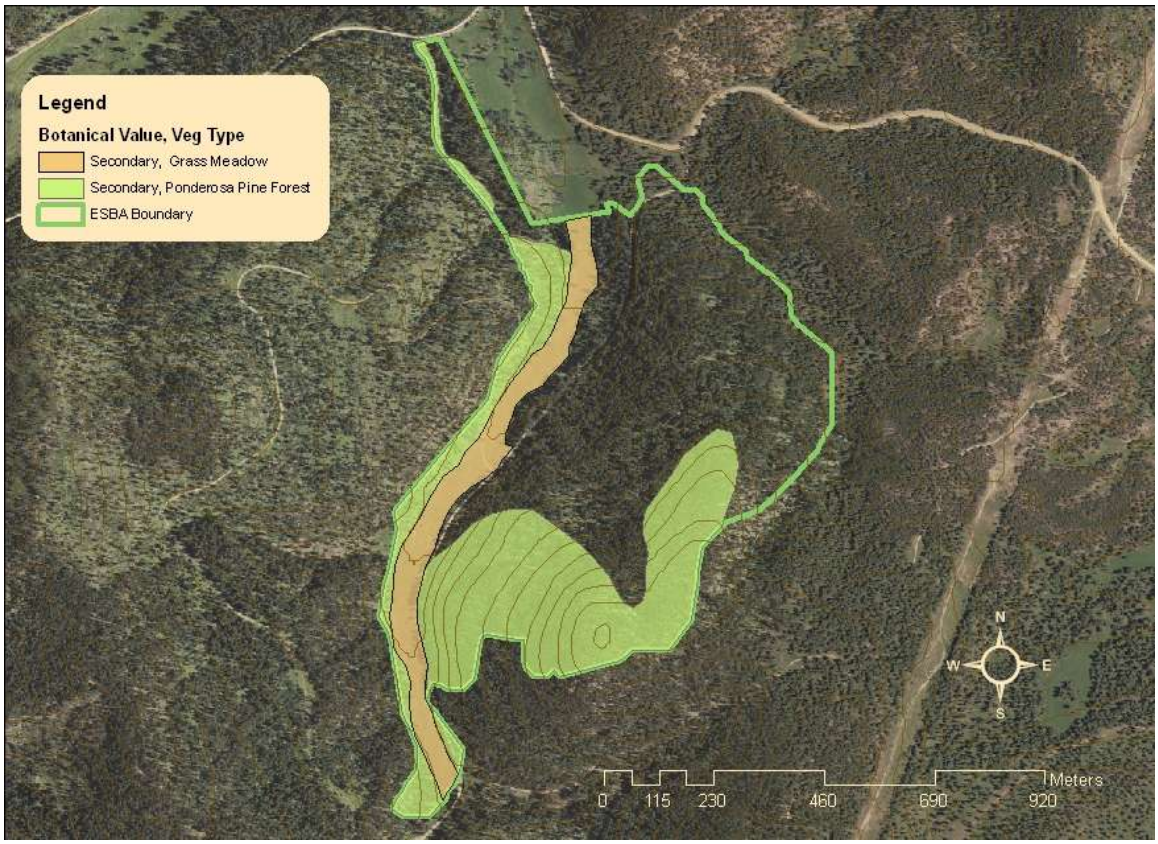

Figure 6. Secondary habitats (shown as colored areas) within ESBA.

6.2.2 *Pinus ponderosa* (Ponderosa Pine)/*Juniperus communis* (Common Juniper) Forest

Northeastern and western exposures as well as ridgetop locations support forest stands dominated by ponderosa pine with a shrub understory of *Juniperus communis* or *Shepherdia canadensis* (russet buffaloberry) (Figure 6, above). 55 acres within ESBA are classified as ponderosa pine forest. This forest type is important as a buffer to the white spruce/twinflower habitat by providing a forested area that reduces edge effects, moderates damaging winds, and tempers rapid changes in temperature and humidity. Another important function is to serve as the vegetative cover on the Pahasapa Limestone

aquifer recharge area (see "Hydrologic Resources", below). However, much of the recharge area is outside of ESBA, extending to the south and east.

Ponderosa pine stands within ESBA are dense, even aged stands (Photo 6). Pine regeneration is very dense, with areas of the forest floor carpeted with seedlings. Ponderosa pine stands are likely at high risk of mountain pine beetle infestation and severe wildfire. Stands may not be optimized for water yield to the primary aquifer recharge area. The small area of pine within ESBA moderates these concerns somewhat, but stands within the designated boundary may require treatment to achieve their best potential as buffers to areas of higher value.

An area of limestone rock outcrop within ponderosa pine forest is found below the southeastern ridgetop of the botanical area boundary. This area provides a unique plant microhabitat within ESBA and should be preserved. While no rare plants are associated with the limestone outcrop, certain plants, such as *Pellaea glabella* ssp. *occidentalis* (western dwarf cliffbrake) are only found within ESBA in the limestone outcrop area.

Photo 6. Ponderosa pine stand near the eastern ridgetop boundary of ESBA.

6.3 Hydrologic Resources

The hydrologic resources of ESBA, including surface water (spring brooks, the perennial stream, and wetland areas), as well as ground water (springs and associated aquifers) are integral to its botanical values. Water quantity, quality, temperature, flow regimes, and chemistry all affect the rare plant

populations, their habitats, and the biological diversity values of the area. At this time, information on these attributes is insufficient to appropriately manage and monitor hydrologic resources for botanical values.

Differences in discharge amounts, flow regimes, landscape position, spring type, and associated riparian floras create hydrologic resources that differ in their contribution to botanical values. Primary hydrologic resources sustain primary botanical habitats such as white spruce alluvial forest and the springhead forest opening, as well as rare plant populations. Secondary hydrologic resources, while intrinsically valuable as high quality ground and surface water resources, lack these important botanical features. However, secondary hydrologic features may be hydrologically connected and contribute water to primary botanical habitats.

6.3.1 Ground Water Resources

Ground water resources within ESBA are various; precise discharge points probably change over time. Results from spring inventories conducted during spring and summer 2010 revealed approximately 24 discharge points (Figure 7; Dempsey 2010). Though there are springs scattered elsewhere, there are four areas where springs are grouped: the hillside springs emerging from a mid-slope position; a series of seeps and upwelling springs within the meadow area; a series of springs just below FSR 228.1 emerging from the toe slope; and two springs which discharge within the northwest arm of the botanical area. Many of these springs outflow into spring brooks of varying lengths, which then join surface streams.

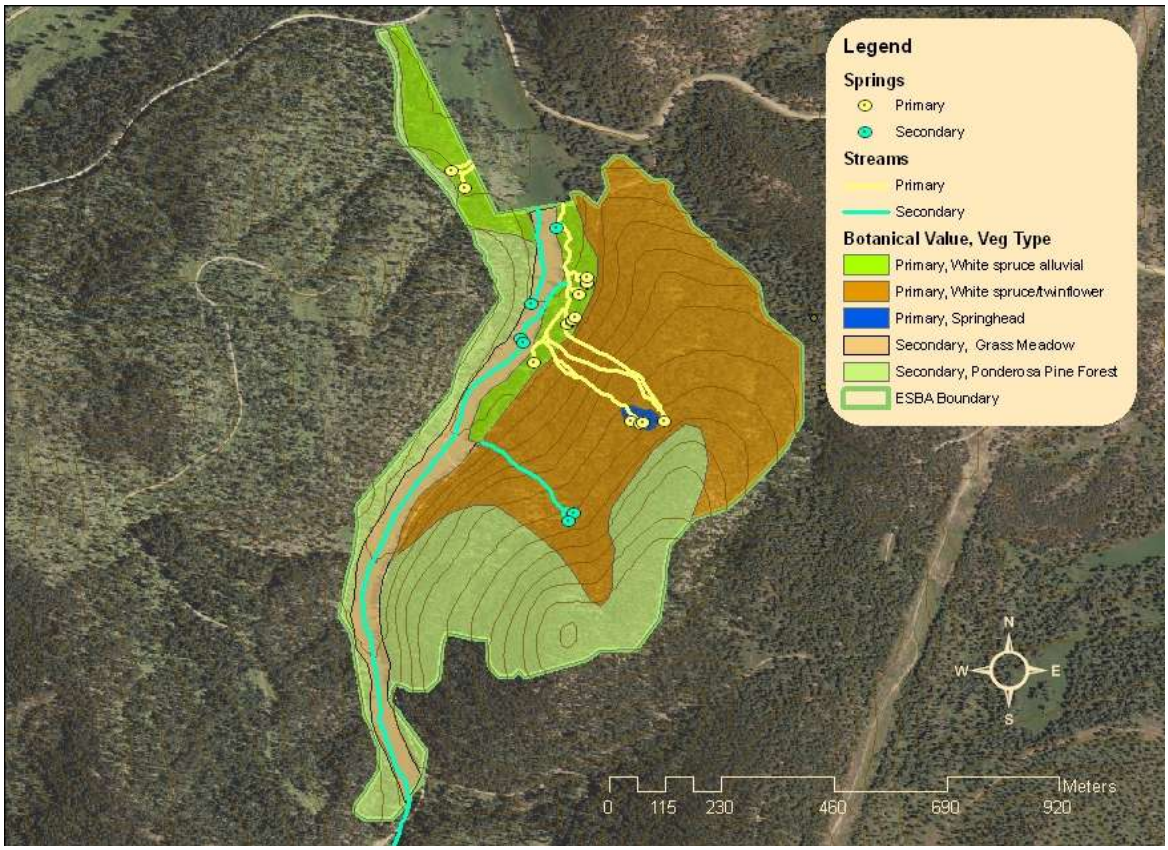

Figure 7. Hydrologic features within ESBA boundary.

It is important to note that the 2010 spring inventory was conducted during a year of above-average moisture after an extended period of drought in the Black Hills region (High Plains Regional Climate Center 2010). Several springs were documented in 2010 that had not been observed before. This variability in climate and ground water discharge adds to the challenge of understanding the hydrologic resources of ESBA and their relation to botanical resources.

The hydrogeology of Englewood Springs has been illuminated by the recent release of the Lead geologic quadrangle map (Redden, Lisenbee, and Fahrenbach 2010). As shown in Figure 4 (geologic map on p. 8), the hillside springs emerge near the contact point between Whitewood Limestone-Winnepeg Formation and the Deadwood Formation. The toe slope springs emerge near the base of the Deadwood Formation. The upper geologic layer in this area is a lobe of Pahasapa Limestone that extends from the upper slopes of ESBA south-southeast for approximately 1.5 miles into the Nahant quadrangle (there is no geological quadrangle map available for Nahant). Portions of this formation north of the syncline passing near the southern boundary of ESBA dip to the north, where the springs are located. This area serves as the primary aquifer recharge area from precipitation for these botanically valuable springs (Dempsey 2010). There may be other sources of water contributing to the aquifer as well.

The overall contribution of Englewood Springs as a high quality water source in the headwaters of the heavily impacted Whitewood Creek watershed was recognized as a special value in documents recommending establishment of ESBA. Many springs and surface waters in the area were developed and diverted to support mining operations and as domestic water for nearby towns. Few springs in the area are intact and undeveloped, further enhancing the value of Englewood Springs as a natural system. The unaltered condition of the springs is a core value of the botanical area.

6.3.2 Primary Hydrologic Resources

As mentioned above, primary hydrologic resources are associated with primary botanical habitats and rare plant populations. These include the hillside springs and spring brooks, toe slope springs and spring brooks, the valley bottom perennial stream, and the springs, spring brooks, and wetland in the northwest arm of the botanical area, and any associated aquifers.

The hillside springs are cool-water, perennial rheocrene seeps (Dempsey 2010, Springer & Stevens 2009; Photo 5). The spring discharge appears to be stable year round, likely an important attribute supporting the unique springhead habitat. The steady flow regime also suggests the springs are connected to a substantial aquifer rather than a minor or perched aquifer. In tests conducted in September 2010 on several of the hillside springs, pH ranged from 8.4 to 8.7 (Dirksen and Larson 2010). This basic chemistry reflects the calcareous geology of the area and is likely another important attribute for the rare plant populations supplied by the springs.

Photo 5. One of the hillside springs photographed in early spring.

The hillside spring discharge forms a series of three small spring brooks that flow down the steep hillside. The spring brooks form a zone of additional moisture which supports rare plants and their habitat along the length of the hillside. The banks of the spring brooks are mossy and very fragile. The spring brooks enter three culverts at FSR 228.1. West of the road, the brooks join with other intermittent spring brooks to form a perennial stream in the valley bottom which flows north to join Whitewood Creek. The main stream channel sustains the alluvial forest and riparian vegetation, rare plant populations, and rare plant habitat in the valley bottom.

The 2010 spring inventory documented a series of springs discharging at the toe of the slope just below FSR 228.1 (Dempsey 2010). These springs form very short spring brooks within the white spruce alluvial forest that contribute to flows in the valley bottom stream. At least three of these springs may be associated with the *Listera convallarioides* subpopulation west of the road, as concentration areas of plants are found in a repeating pattern near where the toe slope springs discharge.

Two springs flow in the alluvial forest in the northwest arm of the botanical area. These springs supply water that supports small areas of wetland vegetation, mosses and liverworts, rare sedge populations, and characteristic areas of white spruce root plates covered in moist forest vegetation and mosses. The moisture in this area also supports the canopy of white spruce alluvial forest.

6.3.3 Secondary Hydrologic Resources

Secondary hydrologic resources are those that are not directly associated with primary botanical habitats or rare plant populations. These include the meadow springs and their associated spring

brooks and wetland, the ephemeral stream in the meadow, and a southern hillside spring complex along with their spring brooks.

The 2010 spring inventory documented a series of five springs in the meadow area. While some of the springs had been observed to flow consistently on a seasonal basis, many of the springs had not been observed before the above-average moisture of 2010. The meadow spring complex is located below FSR 228.1A (the road that bisects the meadow). Above the springs in the meadow, the main surface stream is ephemeral. All of the meadow springs are of the Helocrene spring type, which is characterized by seeping from a shallow, unconfined aquifer (Dempsey 2010, Springer & Stevens 2009). Timing and amount of flow may be related to the valley bottom water table. None of the meadow springs, associated spring brooks, or the small wetland near the northern boundary sustain primary botanical habitat or known rare plant populations.

In the meadow, two closely spaced upper (southern) springs upwell and flow in spring brooks that join the perennial stream in the white spruce alluvial forest. These newly documented springs were not flowing as of July 20, 2010. The moist area surrounding the springs and their apparently intermittent brooks is dominated by the primary meadow vegetation of rhizomatous exotic grasses.

The remaining three meadow springs are more widely spaced down valley to the north. The upper of these two springs has been observed to flow well into late summer. During wetter periods, this spring may be perennial. The discharge area and upper spring brook supports a mixture of mosses and exotic grasses. The spring outflows into a small spring brook that flows north onto private land. This spring brook contributes to the small area of sedge-bulrush wetland vegetation in the lower end of the meadow. The lower spring is near the bank of the perennial stream. This low discharge seep also contributes to the wetland but also flows briefly and joins the perennial stream during times of higher flow. A third spring discharges at the base of the lone spruce tree in the meadow and its spring brook flows briefly before passing onto private land.

The ephemeral stream in the meadow in the valley bottom above the springs is not known to flow. There is an impoundment upstream on private lands which may affect the stream. The ephemeral stream is considered a secondary hydrologic resource as it does not support any known rare plant habitats or populations.

A series of two newly documented springs are located approximately 100 meters south of the hillside springs along the same axis as the main hillside spring complex. The two springs each form a spring brook that join together and flow down the hillside nearly to FSR 228.1. While the springs seem to discharge less water than most of the springs to the north, they may be perennial as they were observed to flow throughout the summer of 2010. The spring brook did not carry enough discharge to continue flowing after reaching the lower gradient toe slope near the road. Here, the flow spreads out and the channel disappears. However, at the spring source and along the upper half of the spring brook, vegetation indicates flows sufficient to sustain moisture-loving plants such as *Glyceria striata*, *Mentha arvensis* (wild mint), *Mimulus guttatus* (monkeyflower), *Marchantia* liverworts, and various mosses. Weeds in this area of additional moisture include *Leucanthemum vulgare*, *Cirsium arvense*, and *Cirsium vulgare*.

Though located within the mapped area of white spruce/twinflower forest, the stand surrounding these two springs is primarily ponderosa pine with mixed conifer regeneration. Prior timber harvest is apparent in the area around the springs and along the slopes where the spring brook flows. These springs support a lesser level of plant diversity and lack the well-developed white spruce-moss riparian habitat of the main spring complex to the north. No rare plant populations are known in this area.

6.4 Rare Plant Populations

There are 11 species of rare plants within ESBA (Table 2; Figure 8). For purposes of assessing the botanical values of ESBA, rare plants are defined as those given conservation rankings by the South Dakota Natural Heritage Program (SDNHP) of S3 or above. State conservation rank values include: S1, species' persistence is critically imperiled within South Dakota; S2, species' persistence is imperiled within South Dakota; and S3, species' persistence is vulnerable within South Dakota. While state conservation-ranked plants exhibit a wide range of overall patterns in distribution and abundance, their status as ranked species signifies they are of conservation concern at the state level. Generally, conservation-ranked plants are important to biological diversity at a regional scale also; many rare plants are of conservation concern in multiple states or have federal protection. All eleven plant species are considered secure globally (G5), meaning that considering their entire range they are at low risk of extinction (NatureServe 2009). Ranks at both the state and global levels are assigned based on a standardized assessment of various factors affecting species rarity, trend, and threats conducted by Natural Heritage Program personnel.

Conservation rankings may change over time depending on new knowledge or changes in species abundance, trends, and threats. Forest Service status such as R2 Sensitive or Species of Local Concern (SOLC) status may also change. If a plant species listed here is no longer ranked S3 or above, it will still be botanically valuable and contribute to the overall plant diversity of ESBA, but may not be a focal point for specific management or conservation strategies. Conversely, newly listed plants that occur within ESBA may need further assessment of their status within ESBA and perhaps warrant specific conservation strategies.

Table 2. Rare plant species within ESBA.

Taxonomic Name	Common Name	Plant Code	State Rank*	FS Status*	Documented at time of BA Designation?	Relocated or found new population during 2009-2010 field work?
Astragalus americanus	Rattlepod; American milkvetch	ASAM3	S3	None	Yes	No
Calypso bulbosa var. *americana*	Fairy slipper	CABU	S3	None	Found after designation	Yes
Carex capillaris	Hair-like sedge	CACA12	S3	None	Yes	Yes
Carex leptalea	Bristly-stalked sedge	CALE10	S3	None	Yes	Yes

Taxonomic Name	Common Name	Plant Code	State Rank*	FS Status*	Documented at time of BA Designation?	Relocated or found new population during 2009-2010 field work?
Corallorhiza trifida	Yellow coral root; early coral root	COTR	S2	None	Yes	No
Cypripedium parviflorum	Lesser yellow lady's slipper	CYPA19	S3?	R2 Sensitive	Found after designation	Yes
Listera convallarioides	Broad-lipped twayblade	LICO5	S1	SOLC	Yes	Yes
Moneses uniflora	Single delight	MOUN2	S2	None	Found after designation	Yes
Orobanche uniflora	One-flowered broomrape	ORUN	S2	None	Found after designation	Yes
Platanthera dilatata var. *dilatata*	Scentbottle	PLDI	S1	None	Yes	No
Vaccinium membranaceum	Mountain huckleberry	VAME	S2	None	Found after designation	Yes

*State rank is from SDGFP 2009. Rank brief definitions: S1 = crticially imperiled; S2= imperiled; S3= vulnerable. "?" denotes inexact rank. FS Status includes Region 2 (R2) Sensitive Species or Black Hills National Forest Species of Local Concern (SOLC).

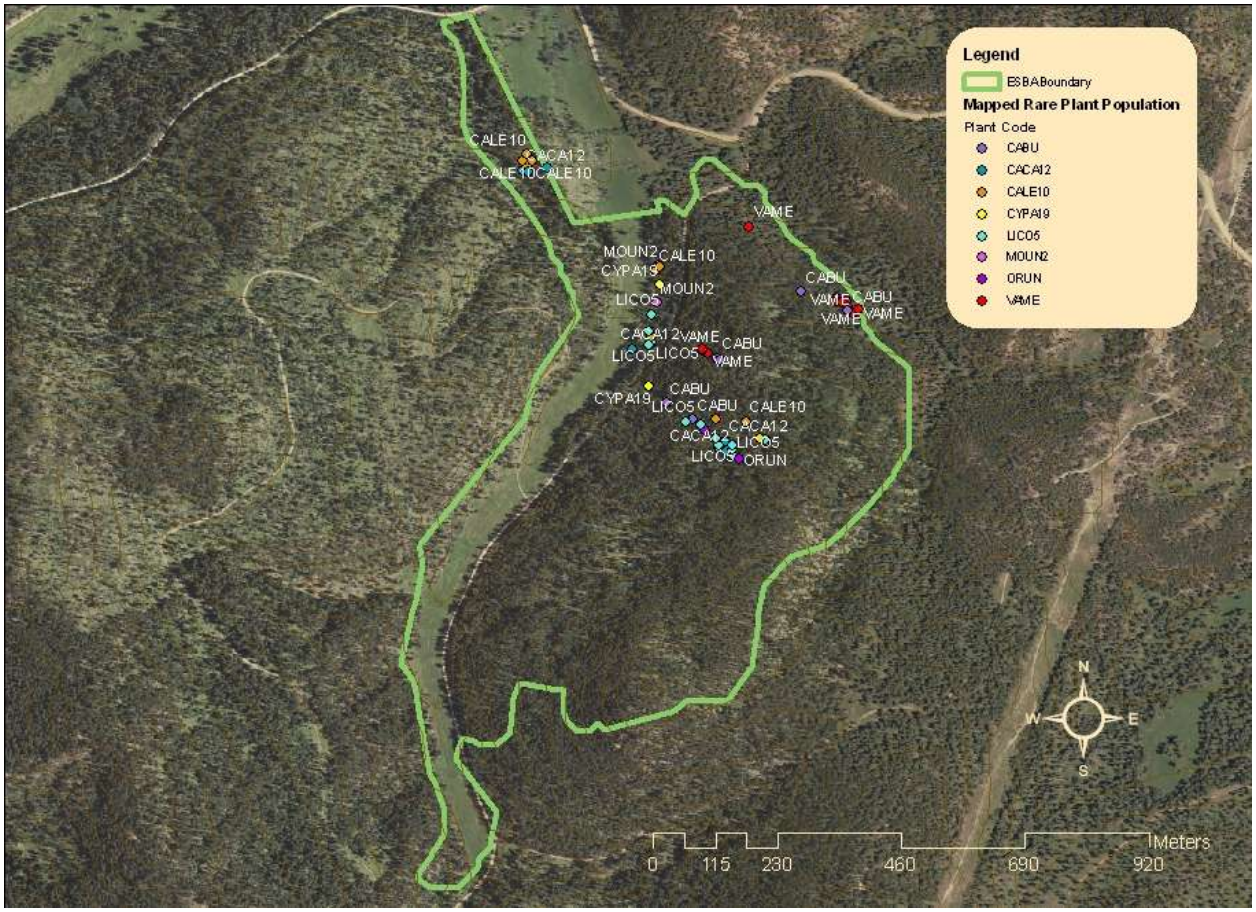

Figure 8. Mapped locations of rare plant populations within ESBA. Refer to Table 2 (above) for plant codes used in the legend.

Six of the rare plant species were documented by Myrtle Kravig or SDNHP within ESBA at the time of establishment (Table 2, above). However, none of the rare plants were identified by name in the 1996 Black Hills National Forest Land and Resource Management Plan Final Environmental Impact Statement or other Forest Service documents related to the establishment of ESBA.

One plant identified at the time of establishment, *Viola macloskeyi* (small white violet), was considered rare at the time but has since been found to be more common than previously thought. It is no longer tracked by SDNHP. Thus it is not considered a rare plant for ESBA, but one of many plant species contributing to the overall floristic diversity of the area.

For all eleven rare plants, more information on population size, trends, and effects of management actions is necessary to provide for specific and appropriate management recommendations and responses. A brief summary of each rare plant's distribution, abundance, habitat, biology, and status within ESBA is presented below.

6.4.1 *Astragalus americanus*

This member of the legume family (Fabaceae) has a boreal distribution pattern and ranges throughout Canada and the northern Rocky Mountains. In Colorado, it is known only from historic records and is

possibly extirpated in the state (NatureServe 2009). It is disjunct in the South Dakota Black Hills and ranked S3 (vulnerable) by SDNHP (SDGFP 2009). Within BHNF, it is known from 15 records in the central and northern Black Hills, and is not known to occur in the Wyoming portion of the Black Hills. Habitats are moist meadows, streamside forests, and thickets adjacent to wet areas (Isley 1998). Black Hills habitats are shaded with moist soil conditions; most sites are in white spruce forest. Most sites are in drainage bottoms or at the base of slopes and are associated with riparian areas or stream terraces.

Astragalus americanus is a perennial that grows from a woody caudex and is somewhat rhizomatous. The importance of vegetative reproduction to the persistence of populations is unknown. As a member of the papilionoid, or pea-flowered, clade of Fabacaeae, bees are likely to be a main pollinator (Cronk 2006, Karron 1987). The plant is considered good forage in Canada where it is more common (Larson & Johnson 1999).

A. americanus was documented in ESBA by Dave Ode in 1983. Ode's documentation stands as the only record of this plant within the designated area. Ode found 8 clumps of plants totaling more than 100 but fewer than 500 plants along the stream channel in the valley bottom west of FSR 228.1. More information is needed on populations, location, and status of *A. americanus* within ESBA. Recent field work did not result in relocation of these plants.

6.4.2 *Calypso bulbosa* var. *americana*

Calypso bulbosa var. a*mericana* is a member of the Orchid family that is circumboreal in distribution, occurring in Eurasia and North America. In North America, it is widespread in the north and primarily follows the Rocky Mountain cordillera south to New Mexico and Arizona (FNA 2002). In the Rocky Mountains, populations are typically found in higher elevations. *C. bulbosa* considered is more secure in the western, mountainous portion of its range, while it is rare in the east and has suffered declines from collecting and habitat loss (NatureServe 2009). In the Black Hills, *C. bulbosa* is found in areas of high elevation limestone bedrock in the Mystic and Northern Hills Ranger Districts (Larson & Johnson 1999, BHNF plant database). There are 159 records for *C. bulbosa* in the BHNF plant database. It is ranked S3 (vulnerable) by SDNHP (SDGFP 2009).

C. bulbosa is a fleshy perennial plant arising from a subterranean corm. It may reproduce vegetatively from the corm or by seed. Like other orchid taxa, *C. bulbosa* is mycorrhizal and produces tiny "dust seeds" that are dispersed primarily by wind and water. The dust seeds lack endosperm and the protective exocarp layer and require mycorrhizal fungi for germination and development. *C. bulbosa* has a single leaf that emerges in late summer, overwinters, and then shrivels shortly after the flower blooms. Bumblebees are the main pollinator (NatureServe 2009, Reeves 2005). Pollination ecology is complex and may be helped by the presence of other flowering plants nearby to bring pollinators into the vicinity. In the eastern portion of its range, *C. bulbosa* was found to require canopy closure of at least 60% and cool forest soils (Schmidt 2003).

Rangewide, *C. bulbosa* habitats vary but the species is generally associated with cool, moist forest vegetation. In the Black Hills, the vast majority of occurrences are in forests dominated by white

spruce from 5,100-7,000 feet in elevation. Mosses are a frequent associate, as are other herbaceous plants typical of cool, moist habitats. Populations range from a single plant to several hundred plants.

C. bulbosa was found in the floristic inventory of ESBA (Photo 7) (Trillium Botanical and Ecological Services 2010). At least two small populations have been found scattered on the slopes of the white spruce/twinflower forest (Figure 8, above). A total of approximately 10 plants have been found to date. Additional occurrences have been found to the northeast just outside of the ESBA boundary (J. Larson, pers. obs.). More information is needed on the status and extent of the populations.

Photo 7. *Calypso bulbosa* var. *americana* growing in needlecast in ESBA.

6.4.3 *Carex capillaris*

Carex capillaris is circumboreal, occurring in northern Eurasia and North America from Greenland to New England states in the east and Alaska to Utah in the west. In the western states, it is restricted to mountainous areas. In South Dakota, it is currently known only from the Black Hills region (USDA 2010). There are historic reports of its presence in northeastern South Dakota (SDGFP 2009). Within the Black Hills region, it ranges from the central to northern Black Hills in Pennington and Lawrence Counties. There are 54 records for *C. capillaris* in the BHNF plant database. It is ranked S3 (vulnerable) by SDNHP (SDGFP 2009).

C. capillaris is a perennial, densely tufted sedge. It is classified as a facultative wetland species, generally requiring moist conditions (USDA 2010). Black Hills occurrences range in elevation from 4,420 to 6,700 feet. Most sites are at least partially shaded by white spruce dominated overstory and are rooted in moist to inundated soils in drainage bottoms and lower slopes. Sites are associated with springs, seeps, riparian areas, and wetlands and often have a thick cover of moss.

C. capillaris was first recorded in ESBA by Dave Ode in 1983 (Ode 1983). *C. capillaris* is found in the white spruce alluvial forest in the valley bottom where an estimated population of 5 plants were found in the 2010 floristic inventory (Trillium Botanical and Ecological Services 2010). The white spruce alluvial forest in the northwestern arm of the botanical area and the springhead forest opening both have larger populations estimated at 51-100 plants (Trillium Botanical and Ecological Services 2010).

6.4.4 *Carex leptalea*

Carex leptalea has one of the widest geographic ranges of any North American sedge and is found from Alaska to Florida. All South Dakota occurrences are from NFS lands (Gage & Cooper 2006). Within the Black Hills region, *C. leptalea* has been found in the Bearlodge Mountains and the central and northern Black Hills. The species was placed on the R2 Sensitive list in 2003, but the discovery of numerous populations on BHNF lead to its delisting. There are 105 records for the species in the BHNF plant database. It is ranked S3 (vulnerable) by SDNHP (SDGFP 2009).

C. leptalea is a perennial, tufted sedge with short rhizomes. It is a wetland obligate species associated with highly organic soils or peatlands. In Colorado and Wyoming, transitional or rich fens, which are higher in nutrients and pH, are a frequent habitat. In the Black Hills, the principle habitat for *C. leptalea* is shrub or tree-dominated wetlands associated with springs or small streams (Gage & Cooper 2006).

C. leptalea was first recorded in ESBA by Dave Ode in 1983 (Ode 1983). Ode's map of the site depicts the plants growing along with *Carex capillaris* and *Listera convallarioides* at the springhead area. This plant was reported by BHNF staff in 2004 growing in the white spruce alluvial forest in the valley bottom and the springhead habitat. At that time, the two subpopulations were estimated to be between 101-500 plants. Additional surveys in 2010 documented two populations estimated at 11-51 plants each in the valley bottom white spruce alluvial forest and between two spring brooks in the white spruce/twinflower forest (Trillium Botanical and Ecological Services 2010).

6.4.5 *Corallorhiza trifida*

This member of the orchid family is circumboreal in distribution. In North America, it is present in Greenland and all Canadian provinces. It ranges south to mountainous areas of northern New Mexico and east from eastern North Dakota to New England states, and south to Missouri (NatureServe 2009). In the Black Hills region, it occupies higher elevations in the central and northern Black Hills, but is not known west of the Wyoming border. BHNF has 45 records of *Corallorhiza trifida* in the plant database. It is ranked S2 (imperiled) by SDNHP (SDGFP 2009).

C. trifida is a solitary or clonal perennial herb that grows from a well developed rhizome. *C. trifida* is strongly mycorrhizal throughout its life cycle; while it is capable of photosynthesis, a recent study showed the plants derive most of their energy from its fungal symbiont (Cameron et al. 2009). The fungi, in turn, receives its carbon from the autotrophic trees of the surrounding forest, forming a "tripartite symbiotic association" (Cameron et al. 2009). The species is largely autogamous or self-fertilizing (FNA 2002). Black Hills populations generally consist of small numbers of ramets, ranging from 1 to 8 stems.

Habitats include deciduous, coniferous, and mixed woods, swamps, mountain woods, and northern uplands; the plant is restricted to cool, moist habitats in the southern portion of its range (FNA 2002). In the Black Hills, *C. trifida* is found in moister habitats than other species of *Corallorhiza* (Larson & Johnson 1999). Almost all occurrences are associated with white spruce dominated forest in or near intermittent or perennial stream bottoms.

This orchid was documented in ESBA by Myrtle Kravig between 1968 and 1972. The precise location is unknown, but the plant appears to have been documented in the springhead habitat along with *Listera convallarioides.* In 1972, Lawrence K. Magrath collected the plant from "marshy spots along the stream" somewhere near the springhead area (Magrath #7595 KANU Herbarium). More information is needed on *C. trifida* within ESBA, as extant records are very limited and the occurrence has not been re-evaluated since its discovery.

6.4.6 *Cypripedium parviflorum*

This showy orchid species is endemic to North America, though a closely related taxon, *Cypripedium calceolus,* occurs in Europe and Asia. *C. parviflorum* is widespread throughout North America north of Mexico (Mergen 2006). In the Black Hills and Bearlodge Mountains, *C. parviflorum* is scattered in small populations throughout the region, but its distribution is centered in areas of calcareous bedrock in the northern Black Hills. Although a R2 Sensitive plant, *C. parviflorum* is among the more frequent of rare plants, with 157 occurrences documented in the BHNF plant database. It is ranked S3? (vulnerable, rank uncertain) by SDNHP (SDGFP 2009).

Like other "dust seeded" orchids, *C. parviflorum* depends upon mycorrhizal relationships for development and seedling establishment. The plant may continue to depend on fungal relationships into adult phases, but this has not been established (Mergen 2006). Plants pass slowly through several developmental stages; adult plants may remain dormant underground, with dormancy possibly related to environmental conditions. Bees (and to a lesser extent, other insects) have been reported as pollinators (Mergen 2006). Shaded plants may persist in a vegetative state without developing flowers or fruit until more open conditions arise (Mergen 2006).

C. parviflorum is found in a variety of habitats. In many parts of its range, it appears most vigorous in seral communities where open conditions or areas of moderate disturbance are available. It is most often found on calcareous soils (Mergen 2006). In the Black Hills region, *C. parviflorum* is more often found on shaded, cool, north facing slopes. Soils are frequently perennially moist or saturated with a litter layer and organic inputs. It is often associated with white spruce or rich hardwood communities in the northern Black Hills.

C. parviflorum was first documented in ESBA in 2004 by BHNF staff, who noted a total of 12 plants scattered in small groups. The plants were found at the springhead habitat and in the white spruce/twinflower forest just above FSR 228.1 along the southern-most perennial spring brook. An additional population of 15 plants was found in 2010 in the white spruce alluvial forest along the valley bottom stream (Trillium Botanical and Ecological Services 2010).

6.4.7 *Listera convallarioides*

Listera convallarioides is widespread across northern North America, though the range is separated into eastern (Newfoundland to Minnesota) and western (Alaska to Arizona) segments (USDA 2010). Southwestern populations are found only at higher elevations (FNA 2002). In South Dakota, *L. convallarioides* is known only from four occurrences in the Black Hills, where it is restricted to a 20 square mile area south of Lead. It is a Black Hills National Forest Species of Local Concern (SOLC) and ranked S1 (critically imperiled) by SDNHP (SDGFP 2009).

L. convallarioides is a somewhat stoloniferous perennial herb in the orchid family (FNA 2002). Most information on its biology is derived from studies of congeners with similar flower morphology. Like other orchid taxa within ESBA, *L. convallarioides* is mycorrhizal and produces tiny "dust seeds" that are dispersed primarily by wind and water. Little is known of the mycorrhizal relationship. Hoy (2002) notes the plants can be locally abundant, growing in large colonies even where it is uncommon. Plants are insect pollinated, though *Listera convallarioides* species do not require a highly specialized pollinator. One study of *Listera convallarioides cordata* found fungus gnats to be an important pollinator (Ackerman & Mesler 1979).

L. convallarioides habitats are typically cool and moist, ranging from rich humus in open woods to boggy meadows. In the Rocky Mountain west, it is restricted to mountainous areas and grows in damp, shaded areas with mosses and grasses (Hoy 2002). Soils are cool and circumneutral (pH 5.5-7.4) to only mildly acidic (FNA 2002). Black Hills habitats are dominated by white spruce and substantial moss cover is noted at all sites. All occurrences are associated with cool water springs or seeps.

L. convallarioides was first documented in the springhead habitat at ESBA by Myrtle Kravig (Kravig 1969). Kravig's discovery was a first record of this taxon in South Dakota and the only known population until 1994, when another population was found a few miles to the northwest. It is the best documented of the rare plants within ESBA, with annual visits by the Forest botany monitoring program. The main population is associated with the southern-most hillside springs where water seeps and flows in the springhead forest opening (Photo 8). There are several thousand plants within the small forest opening. Plants are also scattered along the southern spring brook and moist areas in the forest north of the springhead forest opening. In 2007 a subpopulation estimated at 51-100 plants was found west of FSR 228.1 in the valley bottom white spruce alluvial forest near one of the toe slope seeps. Other subpopulations are found in conjunction with several of the toe slope springs.

Photo 8. *Listera convallarioides* in bud in ESBA.

6.4.8 *Moneses uniflora*

Moneses uniflora (synonym *Pyrola uniflora*) is circumboreal in temperate forests of the northern hemisphere (FNA 2009). It is found throughout northern and western North America, where it extends south into mountainous areas of Arizona. In South Dakota, it is peripheral in the Black Hills region, where populations are scattered in mature white spruce forests of the central and northern Black Hills (SDGFP 2009). There are 46 records for this plant in the BHNF plant database. The SDNHP rank is S2 (imperiled) (SDGFP 2009).

M. uniflora is the only member of its genus and is part of the heath family (Ericaceae). The herbaceous plants arise from horizontal roots and produce a solitary flower from June to August. *Moneses* is autotrophic and does not require mycorrhizal associations to persist (FNA 2009). Little information is available on the ecology, life history, or conservation of *M. uniflora*.

In the Black Hills, most occurrences are found on lower slope or valley bottom locations in shade or partial shade. Most occurrences are in moist forest, but some have been found in riparian habitats next to streams. White spruce is the dominant tree at nearly all known sites. *M. uniflora* was first noted at ESBA in 2007, where it was found growing in the white spruce alluvial forest west of FSR 228.1. Little information was recorded on the population at that time. Approximately 101-500 plants were observed growing at the site in 2010 (Photo 9) (Trillium Botanical and Ecological Services 2010). More information is needed on the requirements of *M. uniflora* as well as its extent, habitat, and ecology within ESBA.

Photo 9. *Moneses uniflora* (with unopened, nodding white flowers) growing in white spruce alluvial forest in ESBA.

6.4.9 *Orobanche uniflora*

Orobanche uniflora is widespread throughout North America north of Mexico. In South Dakota is it known only from the Black Hills region (NatureServe 2009). While its Black Hills distribution is centered in the northern hills, *O. uniflora* occurs from the central core north and west to the Bearlodge Mountains. There are 15 occurrence records in the BHNF plant database, 10 of which are from the Northern Hills Ranger District. It is ranked S2 (imperiled) by SDNHP (SDGFP 2009).

A small perennial herb, *O. uniflora* is a saprophytic plant that lacks chlorophyll, depending entirely on its hosts for energy and nutrients. Hosts for congeners are reported to be various trees and shrubs, mosses, species of *Sedum* (stonecrop), and members of families Saxifragaceae and Asteraceae (Larson & Johnson 1999, Dorn 2001). Seeds germinate in response to chemical cues produced by the host plant. *Orobanche* species may appear suddenly after a soaking summer rain, suggesting underground plants may remain dormant until favorable conditions develop (Larson & Johnson 1999). Flowers are pollinated by bumblebees and possibly other long-tongued bees, though plants may self if not cross-pollinated. In the Black Hills, most occurrences consist of fewer than 5 plants, though three populations are substantially larger, numbering over 50 individuals.

O. uniflora generally grows in moist woods, openings, thickets, and along streambanks. In the Black Hills region, habitats of known sites are variable. Sites range from moist to dry-mesic from drainage bottoms to upper slopes. *O. uniflora* is found in Black Hills montane grasslands and shaded forests. Dominant trees in forested sites are ponderosa pine, white spruce, and paper birch.

O. uniflora was first documented in ESBA in 2004, when it was found growing in the springhead habitat under *Rudbeckia laciniata*. The occurrence consisted of four tightly clustered flowering stalks (likely representing a single individual plant). This occurrence has not been relocated. An additional population of 3 plants was found during the 2010 floristic inventory. This population is located in the white spruce/twinflower forest along a spring brook downstream from the springhead opening (Trillium Botanical and Ecological Services 2010).

6.4.10 *Platanthera dilatata* var. *dilatata*

P. dilatata var. *dilatata* is a North American species that extends from northern Canada to New Mexico in the west and Illinois and Indiana (USDA 2010). In South Dakota, it is known only from the Black Hills region, where there are 6 documented occurrences on NFS lands (one of which is a historic collection; RM 2010). Sites range from the central to the northern Black Hills in Lawrence and Pennington Counties. It is ranked S1 (critically imperiled) by SDNHP (SDGFP 2009).

P. dilatata is another orchid species dependent on mycorrhizal relationships for establishment; this dependence may continue into adult stages. The specific details of the mycorrhizal relationship for this taxon are unknown. As with related taxa, the dust sized seeds are numerous and wind dispersed. The tiny seeds require infection with mycorrhizal fungi for development and germination. As Rasmussen (1995) observes, the mycorrhizal relationship is dynamic and dependent plants may enter dormancy or decline as fungal partners diminish; the stability of orchid populations is closely related to the ecological conditions of their mycorrhizae. The flowers are white and strongly clove scented; hence the common name, scentbottle. Pollinators include moths, butterflies, and possibly bees and flies (FNA 2002).

Rangewide *P. dilatata* habitats include wet meadows, tundra, marshes, fens, stream banks, ditches, seeps, and roadsides (FNA 2002). It is a facultative wetland species, meaning it is most often (but not always) found in wetland habitats (USDA 2010). Black Hills occurrences range from 5,200 to 6,200 feet and are in mossy, moist to saturated wetland areas and seeps. Canopy conditions range from open to partially shaded and are dominated by white spruce. Populations consist of groups of 2 to 30 individuals.

P. dilatata was first documented at ESBA by Myrtle Kravig, where the plant was found “creekside near springhead” in “moist but not marshy soil” (Ode 1983). As one of only 6 documented occurrences in the region, the *P. dilatata* occurrence at ESBA is likely an important contribution to this species’ persistence on NFS lands. Since this occurrence has not been relocated since its discovery in the late 1960s, the status of *P. dilatata* within ESBA is uncertain.

6.4.11 *Vaccinium membranaceum*

V. membranaceum ranges throughout western North America and east into Michigan and Ontario (NatureServe 2009). In the Black Hills, the species is restricted to the northern hills (especially higher elevations in the Lead/Deadwood area) and the Bearlodge Mountains. It is considered S2 (imperiled) in South Dakota (SDGFP 2009). In the Cascades and northern Rocky Mountains, the plant is important commercially as a source of wild huckleberries and the fruits are harvested extensively (FNA 2009).

V. membranaceum is a non-rhizomatous shrub growing to 3 meters tall (FNA 2009). Leaves are deciduous and turn a copper color in the fall. The berries are highly palatable to wildlife and humans. Larson & Johnson (1999) note that plants are sometimes browsed to destruction by wildlife. Black Hills populations appear to be extensively browsed and rarely grow above about 0.5 meter (J. Larson pers. obs.).

V. membranaceum can form large stands in cut over forests in the Pacific Northwest (FNA 2009). In the Black Hills, where the plant is much less common and perhaps at the edge of its ecological tolerances, *V. membranaceum* is found in scattered populations growing in paper birch/beaked hazelnut, aspen, or mixed conifer habitats. It is most frequently found in partially shaded conditions on north aspects between 5,000 and 6,600 feet in elevation. There are 61 records of *V. membranaceum* in the BHNF plant database, with most populations over 100 plants.

V. membranaceum has been recently documented in ESBA as a result of floristic inventory work during the summer of 2010 (Trillium Botanical and Ecological Services 2010). Three populations consisting of several hundred plants have been found in the white spruce/twinflower forest habitat within ESBA (Figure 8, above). The northern population extends east beyond the botanical area boundary.

6.5 Unusual Plant Assemblages and High Species Diversity

ESBA represents moderate to high quality examples of regionally distinct plant species assemblages. As is apparent in the discussion of the individual rare plant species, the vascular plants known from ESBA are indicators of a larger collection of interdependent vascular plants, fungi, lichens, mosses, pollinators, and other wildlife. This includes common species as well as rare and/or sensitive ones and many species not yet identified within the area. This diversity may be viewed through various taxonomic lenses. A few of the more notable assemblages are discussed below.

6.5.1 Orchid Diversity

There are 13 species from the family Orchidaceae represented within ESBA (Table 3). This species diversity is exceptionally rich for this small area of land and has been recognized as an important botanical value underpinning the area's special designation. Orchids have long held human interest for their numerous uses, from ornamental to medicinal. They are also of ecological significance because they typically require high quality habitats undisturbed by human activities. Orchids are notoriously difficult to cultivate due to the mycorrhizal relationships required for plant germination and development; thus they are less likely to be successful targets of restoration or propagation programs, making their *in situ* conservation even more important. Members of the family are also associated with specialized pollinators that may have co-evolved with certain taxa. The 13 taxa within ESBA likely attract a variety of common and uncommon insect pollinators.

Table 3. Orchidaceae known from ESBA

Taxon name	Common name
Calypso bulbosa var. *americana*	Fairy slipper
Corallorhiza maculata	Summer coral root
Corallorhiza striata	Hooded coral root

Taxon name	Common name
Corallorhiza trifida	Yellow coral root
Corallorhiza wisteriana	Spring coral root
Cypripedium parviflorum	Lesser yellow lady's slipper
Goodyera oblongifolia	Western rattlesnake plantain
Goodyera repens	Lesser rattlesnake plantain
Listera convallarioides	Broad-lipped twayblade
Piperia unalascensis	Slender-spire orchid
Platanthera aquilonis	Northern green orchid
Platanthera dilatata	Scentbottle orchid
Platanthera huronensis	Huron green orchid

6.5.2 Sedge Diversity

There are 18 species of sedges (*Carex* spp.) known from ESBA (Table 4). Most of these are obligate (requiring wetland habitat) or facultative (most often found in wetland habitat, but sometimes growing in upland locations) wetland species. Many of these sedges require high quality wetland communities, while others appear have more general habitat requirements. The diversity of sedge species contribute to the botanical values of ESBA as crucial components of the springhead wetland and riparian habitats, as important stabilizers of soils, and as elements that both require and create high quality vegetative communities.

Table 4. Sedge species (*Carex* spp.) known from ESBA

Taxon name	Common name
Carex aurea	Golden sedge
Carex brevior	Shortbeak sedge
Carex capillaris	Hair-like sedge
Carex capitata	Capitate sedge
Carex deweyana	Dewey sedge
Carex disperma	Softleaf sedge
Carex hoodii	Hood's sedge
Carex interior	Inland sedge
Carex leptalea	Bristly-stalked sedge
Carex microptera	Smallwing sedge
Carex microglochin	Few-seeded bog sedge
Carex peckii	Peck's sedge
Carex pellita	Wooly sedge
Carex pensylvanica	Pennsylvania sedge
Carex richardsonii	Richardson's sedge
Carex rosea	Rosy sedge
Carex sprengelii	Sprengel's sedge
Carex utriculata	Northwest territory sedge

6.5.3 Vascular Plant Diversity

Results from a recent floristic inventory of ESBA found 177 plant taxa (Trillium Botanical and Ecological Services 2010). This level of plant diversity is likely moderate to high considering the small area. When

compared to the surrounding ponderosa pine matrix vegetation, small pockets of diversity such as ESBA contribute disproportionately to regional biological diversity. It is important to note that while the floristic inventory was designed to document as many plant species as possible, it is unrealistic to assume that 100 percent of plants species present were captured in the study.

Many other plant species of botanical interest were documented during the floristic inventory (Table 5) (Trillium Botanical and Ecological Services 2010). These plant species may not be of conservation concern locally, but are infrequent or restricted in their range and/or habitat in the Black Hills region or are of conservation concern in neighboring states.

Table 5. Other plant species of interest known from ESBA

Taxon name	Common name
Geum rivale	Purple avens
Hierochloe hirta ssp. *arctica*	Northern sweetgrass
Melica subulata	Alaska oniongrass
Piptatherum pungens	Mountain ricegrass
Pyrola picta	Whiteveined wintergreen
Viola renifolia	White violet

6.5.4 Fungal, Moss, Lichen, and Liverwort Diversity

More information is needed on botanical values relating to mosses, lichen, and fungi within ESBA. There is ample evidence that these groups are integral to the habitats supporting rare plant populations. Moreover, the habitats and hydrology of ESBA likely harbor an uncommon array of these organisms that warrants recognition as an independent botanical value likely to be of regional significance.

As discussed above, Orchidaceae require mycorrhizal fungi to live; many other vascular plant species, including the white spruce forming the overstory of ESBA's most botanically significant habitats, may not require but benefit from fungal symbionts. The availability of mycorrhizal fungi may contribute to the area's resiliency to change and human impacts. There are also numerous non-mycorrhizal taxa which have been observed but not catalogued in the area. Though no inventory of fungal species has been made at ESBA, species diversity is likely to be relatively high.

Several moss species are present within ESBA, though no study has been done to identify them. Species of the genus *Climacium* have been noted at the springhead habitat (Ode 1983). In the springhead area and along the spring brooks, mosses form a mat or substrate out of which many of the rare plant populations grow. The moss substrates appear to intercept and disperse spring water flows to create a stable, moist habitat uniquely suited to the plants' requirements. Mosses are a key contributor of organic matter for the deep, organic soils required by plants such as *Carex leptalea* and *Listera convallarioides*. Mosses also colonize woody debris on the forest floor, creating habitats on "nurse logs" for a variety of plant and animal species.

A variety of lichens and liverworts have been observed at ESBA, but no inventory is available at this time. These organisms are important not only for their contribution to the species diversity of the

area, but also as indicators of habitat quality. Lichens are used as surrogates for air quality in some areas, as they are especially sensitive to habitat degradation by nitrogen and acid deposition. Liverworts are found along cool, fast flowing waters throughout the Black Hills. *Marchantia* species were noted by SDNHP in the springhead habitat (Ode 1983) and are an important vegetative component along stream banks in the white spruce alluvial forest (Photo 10).

Photo 10. *Marchantia* species (liverwort) along stream bank in ESBA.

6.6 Other Contributing Values

6.6.1 Ecological and Research Significance

ESBA encompasses a small but intriguing natural system, one that can inform our understanding of the dynamics of such places. All of the botanical values and other attributes described above as well as the isolated context of the Black Hills region have shaped the ecology and evolution of this small area. The area's unique properties may inform researchers and land managers on the geological and ecological processes that have given rise to the cool, boreal disjunct vegetation types endemic to the Black Hills. While the ecology of the Black Hills ponderosa pine forests have been studied for decades by forestry researchers, other forest types of the region are not well characterized. White spruce forests, their relationships to the dominant vegetation, and their role in the ecology of the Black Hills are subjects that warrant further investigation and description. Furthermore, the area continues to retain its special characteristics despite the significant historical and ongoing human impacts within ESBA and the surrounding area. This makes ESBA a suitable place to examine ecological thresholds and

resiliency. Such investigations are critical to developing management approaches to potential climate-change related shifts in vegetation and species distributions in the Black Hills and beyond.

7 Desired Conditions

7.1 Purpose of Desired Conditions

Desired conditions are intended to provide a comprehensive vision of ideal conditions that are attainable over the long term. These ideal conditions may be influenced by large scale factors such as severe drought or climate change which may result in changed circumstances for the botanical area and its resources. Short term management objectives for the botanical area may not fully realize long term desired conditions, but should be designed to move the area toward attainment of desired conditions.

7.2 Desired Conditions for Englewood Springs Botanical Area

Desired conditions for ESBA place primary emphasis on enhancement and conservation of the botanical values described above, including discrete elements (such as rare plant populations) and ecological processes (such as forest succession or hydrologic cycles). The overall vision is for a species-rich, healthy, natural forest and riparian community that serves as an outstanding example of the cool, moist, boreal disjunct white spruce habitats endemic to the Black Hills. Accomplishment of some of the specified desired conditions necessitates a better understanding of the ecological characteristics of ESBA. An adaptive management approach would likely be beneficial in this situation.

Primary botanical habitats are uninterrupted by roads, fences, or other constructed features. Primary habitats have intact mycorrhizal networks and soil horizons, unimpeded movement of insect and animal pollinators and dispersal agents, continuous cover of native vegetation, and sustain natural flow patterns of surface water.

The botanical area boundary encompasses all primary hydrologic resources, contains all continuous primary botanical habitats, provides for connectivity between botanical habitats, provides appropriate buffering vegetation, and facilitates management of botanical resources.

Forested habitats (primary and secondary) are in dynamic equilibrium, with appropriate canopy cover and tree density, multiple age classes, and a variety of microhabitats. Small pockets of aspen, paper birch, and other deciduous trees are present. Natural disturbance processes, such as insect outbreaks, fire, and windthrow occur but are in balance with climax forest conditions. There is sufficient understanding of white spruce forest ecology to facilitate accomplishment of management objectives.

Ponderosa pine stands are open, mature stands. They have an uneven structure and low stocking of smaller trees. Stand characteristics maximize resiliency and water yield to underlying aquifer recharge areas while moderating fire and mountain pine beetle risk.

Secondary meadow habitat contributes to the botanical area as a connecting area and ground water resource. Secondary meadow habitat provides vegetative cover sufficient to maintain water quality

and sustain function as a connecting area between primary botanical habitats. Noxious weeds in the meadow are controlled such that they do not spread into primary botanical habitats.

Native vascular and non-vascular plant diversity is sustained throughout the botanical area. In primary habitats, high quality native plant communities lack noxious weeds and substantial cover of exotic species. There is a prevalence of plant indicator species that are typically absent from degraded habitats. Riparian areas support lush stands of woody vegetation, sedges, mosses, and liverworts. White spruce habitats maintain healthy trees, sufficient canopy cover, and a complement of understory vegetation that typifies cool, moist growing conditions and lack of human disturbance.

Rare plant populations are healthy and vigorous. They grow in enough numbers and retain sufficient resiliency to persist through drought, insect outbreaks, and other cyclic disturbances. Suitable habitats are occupied, and habitats are connected by continuous high quality native vegetation. Requirements for reproduction and all life cycle stages are met. There is sufficient knowledge of such requirements to facilitate accomplishment of management objectives. Monitoring of rare plant populations is adequate to respond to change and evaluate effectiveness of management.

Primary ground-water resources such as springs and spring-fed wetlands maintain sufficient volume, perennial flows, cool temperatures, high water quality, healthy soils and vegetation, and hydrologic functioning to support rare plant populations and botanical habitats reliant on them. Primary and secondary springs, streams, and wetlands are in a natural condition lacking development or diversion for other resource uses. Surface streams are functioning to their potential and support high water quality and perennial flows. Monitoring for achievement or maintenance of desired hydrologic conditions is adequate to respond to change and evaluate effectiveness of management.

8 Management Recommendations

A series of management recommendations follow, based on the botanical values, current conditions, and desired conditions for ESBA described above. These recommendations are meant to fill in gaps in the Forest Plan direction for MA 3.1 or provide more explicit direction for ESBA in light of the known botanical values. Though these recommendations are specific to ESBA, they are general in nature. New information, new conditions, or other circumstances may necessitate approaches and activities different from these recommendations.

8.1 Forest Management

- Active management of ponderosa pine stands within ESBA may be required to maintain their buffer function and desired stand conditions. Approaches may include thinning, removal of commercial and non-commercial size trees, and removal of pine from the meadow. Silvicultural treatments of pine should be designed to move stands toward desired conditions while minimizing the number of entries.
- Management of forest stands on the Pahasapa Limestone aquifer recharge area south-southeast of ESBA should promote water yield.

- Mixed conifer stands with white spruce regeneration within ESBA should be left to transition to white spruce canopy or mixed white spruce-ponderosa pine canopy. Reassess management if white spruce and mixed conifer stands are not moving toward desired condition.
- There are several small hardwood inclusions scattered throughout ESBA and one larger aspen inclusion in the northeastern portion of the botanical area. These inclusions are likely to decline over time without natural disturbance or active management. While this diversity is desirable, active management of small inclusions in primary botanical habitats is not recommended due to the emphasis on natural processes in these areas. The large aspen inclusion may be treated for conifer encroachment by non-mechanical methods.
- In general, mountain pine beetle is not a threat to the botanical values of ESBA. Moving pine stands toward desired conditions and management that promotes ground water recharge should also reduce mountain pine beetle risk in these stands. High levels of pine mortality may result in short-term reduction of the buffer function of ESBA pine stands.

8.2 Rangeland Management

- Livestock grazing is not suitable for areas of primary botanical value.
- Livestock grazing in the portion of the secondary meadow habitat above the meadow springs does not pose a threat to hydrologic or primary botanical resources. The District Botanist and Rangeland Management Specialist should work in collaboration to develop objectives for any areas grazed within the botanical area boundary.
- The portion of the secondary meadow where intermittent springs emerge and flow should be protected from livestock. These secondary hydrologic resources are intermittent but may saturate the lower meadow at the northern end of the botanical area for a substantial portion of the grazing season. Desired conditions are for this area to have sufficient vegetative cover to maintain water quality and for the area to support springs and streams in a natural condition.
- Due to ESBA's location within the Upper Elk Creek Allotment, cattle passage through the botanical area may be needed. Cattle passage measures should be designed to minimize impacts to the botanical area.

8.3 Noxious Weeds

- Integrated management techniques will be needed on an ongoing basis to manage noxious weed populations. Herbicide use in accordance with established practices is acceptable in secondary habitats. In primary botanical habitats, proximity to rare plant populations should be considered as the key factor in determining appropriate control methods. Hand weeding is the preferred method where weeds are growing along with rare plants. Outside of the immediate presence of a rare plant, targeted herbicide application is acceptable under the supervision of a qualified botanist.
- Weed management should be flexible and highly coordinated between the District Botanist and weed management staff. Weed management personnel should receive a rare plant orientation specific to ESBA prior to herbicide application in primary botanical habitats.

- Eradication of all noxious weeds throughout the entire botanical area is unrealistic. *Cirsium arvense, Cirsium vulgare, Cynoglossum officinale,* and *Leucanthemum vulgare* are found throughout the botanical area with numerous well-established populations. Control with a focus on preventing weed spread and establishment of new weed species is appropriate in secondary habitats. In primary habitats, rare plant concentration areas are the top priority. Control with a focus on eradication should be the goal in these areas.
- Certain weed species found in ESBA are currently limited to small areas and should be a high priority for eradication. These weed species are: 1) *Euphorbia esula* (leafy spurge), 2) *Tanacetum vulgare* (common tansy), and 3) *Arctium tomentosum* (burdock).
- Priority areas for weed control are 1) the springhead forest opening, 2) along Road 228.1, especially to prevent weed spread, 3) the grass meadow, especially to prevent spread of *Cirsium arvense* and *Leucanthemum vulgare*, 4) moist areas near springs and spring brooks in the white spruce/twinflower forest, 5) the white spruce alluvial forest in the valley bottom, and 6) the northwestern white spruce alluvial forest. Weed treatment resources should be focused according to priorities.

8.4 Recreation

- Public recreation should be minimal and undeveloped in consideration of the fragile botanical habitats. ESBA offers solitude, dispersed recreation, and the opportunity to observe and study nature.

8.5 Fire and Fuels

- Due to the small size of ESBA, fuels treatments to minimize fire hazard to botanical resources are best accomplished in the landscape surrounding ESBA. Several stands to the east and south of the botanical area have been recently harvested or are part of currently active timber sales, thus reducing fire risk in the area. Prescribed burning may also occur for a portion of this area outside of ESBA.
- Prescribed fire could be a useful tool to promote desired conditions for ponderosa pine stands within ESBA. However, due to the treatments taking place in the landscape surrounding ESBA described above, prescribed fire for fuels reduction within the botanical area is not recommended at this time. However, prescribed fire opportunities could be considered as a future management option.

8.6 Water Resources

- Secure a water right sufficient to sustain botanical resources at ESBA.
- Allow no well development on NSF lands on the Pahasapa Limestone caprock formation that extends south-southeast of ESBA.

8.7 Mineral Resources

- Mining is a potential threat to the Pahasapa Limestone caprock formation that serves as the primary aquifer recharge area. This area, which extends south-southeast outside of the

botanical area boundary, should be considered when pursuing a mineral withdrawal per Forest Plan Standard 3.1-1501.

8.8 Revegetation

- Preferred plant materials for revegetation are locally propagated native plants. Natural succession may also be appropriate if noxious weeds can be prevented from establishing.
- Non-local sources may be used if quick establishment of ground cover is required to prevent soil erosion and no local native stock is available. A non-persisting annual would be preferred in this situation. The revegetated area should be monitored to ensure that the seeding is performing as expected.

8.9 Transportation

- Reclamation of the segment of Road 228.1 passing through primary botanical habitat within ESBA could enhance botanical values, restore natural flow patterns of the hillside spring brooks, and address erosion at the road culverts. Protection of rare plant populations and the toe slope springs just below the road should be a primary consideration in such an undertaking. Planning for appropriate revegetation would also be an important consideration.
- Road 228.1A (see Figure 2 on p. 4 for a map of area roads), which crosses the meadow, may be used for administrative access with no adverse impacts to primary botanical resources.
- The northern segment of Road 707.1 (see Figure 2 on p. 4 for a map of area roads), which follows near the western botanical area boundary along the northwestern arm from the Mickelson Trail, may be used for administrative access with no adverse impacts to primary botanical resources. However, this road passes on or near springs of primary botanical value as the road travels to the southeast and ends at the private land boundary. This short segment of road should be closed to all uses.

9 Management Objectives and Monitoring Plan

9.1 Management Objectives

Objective-based monitoring is a key aspect of implementing this management strategy. Forest Plan objective 3.1-201 also calls for monitoring to determine if botanical features are being maintained. The development of management objectives generally follows the methods and recommendations set forth in Elzinga, Salzer, and Willoughby (1998), who define objectives as “clearly articulated descriptions of a measurable standard, desired state, threshold value, amount of change, or trend that you are striving to achieve for a particular plant population or habitat characteristic. Objectives may also set a limit on the extent of an undesirable change.” (p. 41.)

An important consideration in the development of management objectives and monitoring is the availability of resources to accomplish the ongoing work of performing monitoring and reporting results. Our goal is for monitoring to consume no more than 6 person days in the field per year and 3 person days in the office (after initial set up and pilot study analysis). Development of community partnerships to accomplish portions of the monitoring would be beneficial.

Many important botanical values, such as plant species diversity, are difficult to measure directly and to determine appropriate thresholds. The influence or impacts of management may also be difficult to quantify. In order to help focus development of management objectives, three broad areas have been identified as important subjects: 1) rare plant populations, 2) hydrologic resources, and 3) noxious weed populations. Other objectives may be developed in the future to assess the success of specific management actions designed to conserve or enhance botanical resources or to address potential threats to botanical values.

For the five years following implementation of this management strategy, management objectives are:

1. Maintain *Listera convallarioides* population frequency and distribution within ESBA over 5 years.

   Rationale: *Listera convallarioides* is the rarest and likely one of the more sensitive species within ESBA. Because of its apparent reliance on particular ground water conditions, moss cover, mycorrhizal fungi, and other narrow habitat requirements, trends in *Listera convallarioides* populations may indicate changes in hydrology or other biological factors that could impact other rare plants with similar requirements. Present *Listera convallarioides* distribution includes the core population at the springhead forest opening, scattered groups of plants in moist seep areas within the white spruce/twinflower forest, and scattered groups along the toe slope springs and valley bottom white spruce alluvial forest. Monitoring of scattered subpopulations outside of the core area may give the earliest signal of population change.

2. Reduce disturbed soils in primary botanical habitat, as indicated by attainment of at least 75% vegetative cover in each identified affected area in 5 years.

   Rationale: The lower reaches of the hillside spring brooks, road culverts, and the lower reach of the valley bottom stream have disturbed soils due to a combination of livestock impacts and (for the road culverts) erosion along the road cut. Disturbed and bare soils within ESBA indicate unacceptable habitat degradation. Revegetation of disturbed soils will contribute to a number of desired conditions, including a lack of noxious weeds, continuous native plant cover within primary habitats, native plant diversity, and maintaining high water quality of streams.

3. Maintain water quality at the hillside springs over 5 years.

   Rationale: The specific attributes that contribute to the functioning of botanically important springs is unknown, but likely involves flow, temperature, pH, and other factors. A baseline of physical and chemical attributes of springs of primary botanical value is needed. Ongoing monitoring of certain water quality indicators could help in early detection of changes that could negatively impact botanical values.

4. Reduce noxious weed populations in primary botanical habitats, as indicated by a measurable decrease of 50% in noxious weed cover within identified areas in 5 years.

Rationale: Noxious weeds are scattered throughout ESBA, and grow along with rare plants in many areas. The presence of noxious weeds in ESBA indicates degraded botanical habitats. The impacts of noxious weeds on rare plant populations is unknown, but could include both positive and negative interactions, such as additional shading (which could benefit rare plants) and increased competition (which may be detrimental to rare plants). Reducing weed cover in conjunction with rare plant monitoring will allow for assessment of weed control impacts on rare plants. Also, reducing noxious weed cover may promote native plant diversity and cover.

9.2 Monitoring

This monitoring plan covers the initial five years of this management strategy. The success and usefulness of the monitoring plan should be evaluated throughout this five-year period, and adjusted as needed (a two-year pilot study is specified for quantitative plant monitoring methods). At the end of the initial five year period, the monitoring plan may be continued or altered based on monitoring results, new information, or changed conditions. Less intensive monitoring may be implemented if results show consistent stability in parameters, or resources are unavailable to accomplish the monitoring recommended here. Monitoring for any target-based objective may also be discontinued during the five period if the target is reached.

For each management objective outlined above, there is an accompanying monitoring protocol to assess achievement of the objective. Management responses are also specified.

1. Maintain *Listera convallarioides* population frequency and distribution within ESBA over 5 years.

Measurement: Monitoring methods that minimize impacts to the fragile habitats of *Listera convallarioides* populations are an important consideration. The primary goal is to detect a significant decline in *Listera convallarioides*. A pilot study measuring frequency by reproductive and vegetative classes will be used. Macroplots will be distributed among *Listera convallarioides* subpopulations. Detection of a 30% decline at a confidence of at least 80% is desired. Monitoring will be done once annually for the five year period. The pilot study will be evaluated after years 1 and 2 and adjusted to meet the above requirements. Detailed design of the pilot study is included in Appendix B.

Management response: If monitoring results show a 30% decline for 2 years in a row or a 50% decline in any one year for any subpopulation, an investigation of the cause of the decline will be initiated and documented in a brief report by a qualified botanist. Management response should address the cause of the decline if possible. Causal factors outside of management control should also be documented. If the cause is not apparent, more intensive monitoring designed to identify factors causing the decline will be implemented. Note that this more comprehensive monitoring protocol will replace the *Listera convallarioides* monitoring protocol specified in the Black Hills National Forest North Zone Range 2008 Environmental Assessment.

2. Reduce disturbed soils in primary botanical habitat, as indicated by attainment of at least 75% vegetative cover in each identified affected area in 5 years.

Measurement: This objective will be measured by establishing line intercept transects in areas of disturbed soil along the lower end of the valley bottom stream, and the lower reach of the southern hillside spring brook. The total amount of vegetative cover will be measured along each transect. Cover will be measured once annually for five years. Naturalized exotic species, while not ideal, are well established in areas adjacent to disturbed soils and will be counted toward achievement of this objective. Noxious weed species will not count toward achievement of this objective. Each area should reach the 75% target individually. Detailed design for measurement of this objective is included in Appendix B.

Management response: Much of the areas of concern may revegetate naturally with exclusion of livestock from primary botanical habitats. Noxious weed control (likely hand pulling for small areas) may be needed to favor establishment of native species. Larger areas and areas that show no progress toward the target plant cover increase within 2 years of implementation may need more intervention. Seeding or transplanting or a combination may be needed to reestablish vegetative cover in these areas. Plant species and techniques used will depend on the habitat.

3. Maintain water quality at the hillside springs over 5 years.

Measurement: Water quality will be measured through five core parameters: 1) temperature, 2) specific conductance, 3) pH, 4) dissolved oxygen (DO), and 5) flow. Measurements will be taken twice per year, in the spring and fall. Sampling will occur at least three discharge points at the hillside springs. Protocols and methods will follow standard procedures such as those available from the EPA.

Management response: It is recognized that management may have little control over these parameters. The State of South Dakota is the entity with primary responsibility for water quality. However, these parameters are relatively easily measured and will at least provide an understanding of the range of variability of water quality parameters that could affect rare plant habitats and populations. A variation of more than 50% in any parameter between the same season of different years will be investigated.

4. Reduce noxious weed populations in primary botanical habitats, as indicated by a measurable decrease of 50% in noxious weed cover within identified areas in 5 years.

Measurement: Measurement of this objective will utilize four randomly placed line intercept transects that measure the total percent cover of all noxious weeds along the transect. Transects will be read once annually for five years. Details are included in Appendix B.

Management response: If monitoring results do not indicate a downward trend for all noxious weed species within two years, control methods, timing, and intensity will be

evaluated. Control efforts will be increased or otherwise adjusted if the desired downward trend is not occurring.

10 Literature Cited

Ackerman, J.D. and M.R. Mesler. 1979. Pollination biology of *Listera convallarioides cordata* (Orchidaceae). Amer. J. Bot. 66(7): 820-824.

Cameron, D.D., K. Preiss, G. Gebauer, and D.J. Read. 2009. The chlorophyll-containing orchid *Corallorhiza trifida* derives little carbon through photosynthesis. *New Phytologist* 183:358-364.

Cronk, Q.C.B. Legume flowers bear fruit. 2006. *PNAS* 103:13, 4801-4802.

Dempsey, Melissa. August 20, 2010. Preliminary spring inventory report. USDA Forest Service Black Hills National Forest, Northern Hills Ranger District. Unpublished, on file at Northern Hills Ranger District, Spearfish, South Dakota.

Dirksen, Robin and J. Larson. September, 2010. Water quality data collected by chemistry students of Lead-Deadwood High School. Unpublished, on file at Northern Hills Ranger District, Spearfish, South Dakota.

Dorn, Robert D. 2001. Vascular Plants of Wyoming, 3rd Ed. Mountain West Publishing, Cheyenne, Wyoming.

Elzinga, C.L., D.W. Salzer, and J.W. Willoughby. 1998. Measuring and Monitoring Plant Populations. Bureau of Land Management Technical Reference 1730-1. Bureau of Land Management National Business Center, Denver, Colorado.

Flora of North America Editorial Committee (FNA). 2002. Flora of North America, Volume 26: *Magnoliophyta: Liliidae: Liliales and Orchidales*. Oxford University Press, New York.

Flora of North America Editorial Committee (FNA). 2009. Flora of North America, Volume 8: *Magnoliophyta: Paeoniaceae to Ericaceae*. Oxford University Press, New York.

Froiland, Sven G. 1978. Natural History of the Black Hills, South Dakota. Center for Western Studies, Sioux Falls, South Dakota.

Gage, E. and D.J. Cooper. 2006. *Carex leptalea* Wahlenberg (bristly-stalked sedge): a technical conservation assessment. USDA Forest Service, Rocky Mountain Region. Available: http://fs.fed.us/r2/projects/scp/assessments/carexleptalea.pdf.

High Plains Regional Climate Center, University of Nebraska, Lincoln, Nebraska. 2010. Data from Lead COOP Station. Available http://www.hprcc.unl.edu (accessed September 1, 2010).

Hoy, Joann M. 2002. *Listera convallarioides* (broad-leaved twayblade) conservation and research plan for U.S. Forest Service Region 9. New England Wildflower Society, Framingham, MA. Available http://www.newfs.org.

Isley, D. 1998. Native and Naturalized Leguminosae (Fabaceae) of the United States. Brigham Young University Press, Provo, Utah.

Karron, J.D. 1987. The pollination ecology of co-occurring geographically restricted and widespread species of *Astragalus* (Fabaceae). Biological Conservation 39(3):179-193.

Kravig, Myrtle. L. 1969. Orchids of the Black Hills. Proc. SD Acad. Sci. 48: 119-131.

Larson, Gary E. and James R. Johnson. 1999. Plants of the Black Hills and Bear Lodge Mountains. South Dakota State University, College of Agriculture and Biological Sciences, Brookings, South Dakota.

Marriott, Hollis J., and Don Faber-Langendoen. 2000. Black Hills Community Inventory, Vol. 2: Plant Community Descriptions. The Nature Conservancy and Association for Biodiversity Information, Minneapolis, Minnesota.

Mergen, D.E. 2006. *Cypripedium parviflorum* Salisb. (lesser yellow lady's slipper): a technical conservation assessment. USDA Forest Service, Rocky Mountain Region. Available: http://www.fs.fed.us/r2/projects/scp/assessments/cypripediumparviflorum.pdf.

NatureServe. 2009. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: May 28, 2010).

Ode, David J. 1983. South Dakota Natural Heritage Program data forms for site F83NHP03. South Dakota Department of Game, Fish, & Parks (SDGPF). Unpublished, on file Northern Hills Ranger District, Spearfish, SD.

Parker, Watson and H.K. Lambert. 1974. Black Hills Ghost Towns. Sage Books, Chicago.

Raisch, Bruce. 2006. Ghost Towns and other historical sites of the Black Hills. Donning Co. Publishers, Virginia Beach, VA.

Redden, J.A., A.L. Lisenbee, and M.D. Fahrenbach. 2010. Geologic map of the Lead quadrangle, South Dakota, 7.5 minute series geologic quadrangle map 11. South Dakota Dept. of Environment and Natural Resources, Division of Financial and Technical Assistance, Geological Survey Program. Vermillion, SD. Available http://www.sdgs.usg.edu/pubs/pdf/GQ24k-11_20100630.pdf (Accessed 11/15/10).

Reeves, Sonja L. 2005. *Calypso bulbosa*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available http://www.fs.fed.us/database/feis. (Accessed June 21, 2010).

Rocky Mountain Herbarium (RM). 2010. Online specimen database available http://www.rmh.uwyo.edu (Accessed June, 2010).

Schmidt, Lori J. September 2003. Conservation assessment for *Calypso bulbosa* (Fairy slipper). USDA Forest Service, Eastern Region. Available: http://www.fs.fed.us/r9/wildlife/tes/ca-overview/docs/Plants/Fairy%20Slipper.pdf.

South Dakota Dept. of Game, Fish & Parks (SDGFP). 2009 (November). Rare, threatened, and endangered plant species tracked by the South Dakota Natural Heritage Program. Available http://www.sdgfp.info/Wildlife/Diversity/RarePlant.htm.

Springer, A. E. and L. E. Stevens. 2009. Spheres of discharge of springs. *Hydrogeology Journal* 17:83-93.

Trillium Botanical and Ecological Services, LLC. November, 2010. Englewood Springs Botanical Area Draft Floristic Survey Report prepared for Black Hills National Forest. Unpublished, report on file at Black Hills National Forest Supervisor's Office, Custer, South Dakota.

USDA, Forest Service. 1997. Revised Land and Resource Management Plan. Black Hills National Forest. Custer, SD.

USDA, Forest Service. 2006. Black Hills National Forest 1997 Revised Land and Resource Management Plan Phase II Amendment. Custer, South Dakota.

USDA, Natural Resource Conservation Service (NRCS). 2010. The PLANTS Database (http://plants.usda.gov, 28 May 2010). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

USDA, Soil Conservation Service (SCS). 1979. Soil survey of Lawrence County, South Dakota. Available online http://soils.usda.gov/survey/online_surveys/south_dakota/SD081/lawrence.pdf. (Accessed Dec 13, 2010)

Appendix A: Forest Plan Direction Relevant to Englewood Springs Botanical Area

The following excerpts from the 2005 Phase II Amendment of the 1997 Revised Black Hills National Forest Land and Resource Management Plan are relevant to ESBA because they address botanical areas or sensitive and species of local concern plants. Other general Forest Plan provisions not excerpted here also may also apply to the area.

OBJECTIVES

Objective 216. Manage to conserve or enhance the integrity of the following important botanical areas:

(e) Englewood Springs

Objective 221. Conserve or enhance habitat for R2 sensitive species and species of local concern (SOLC). Monitoring will be conducted at a Forest-wide level, not at the project level, and will be done for habitats or populations.

Objective 234. Create or maintain a moderate-to-low crown-fire hazard adjacent to occurrences of R2 sensitive and species of local concern plants and botanical areas bordered by continuous, dense conifer stands where long-term persistence is at risk from a single high-intensity fire.

STANDARDS AND GUIDELINES

Sensitive Species Protection and Management

Standard 3119. Issue permits to collect sensitive species or species of local concern plants or plant parts only for scientific or educational purposes, but not for commercial or personal use except for the provisions of Standard 7103. Such collection must not jeopardize the continued vigor or existence of a plant population. Collecting of plants or plant parts in…Management Area 3.1 Botanical Areas…shall not be allowed except by permit issued by the Forest Supervisor for scientific or educational purposes.

Fire Suppression

Standard 4102. Protect heritage resources, R2 sensitive species and plant species of local concern (SOLC), botanical areas (BAs), research natural areas (RNAs), streams, stream banks, shorelines, lakes and associated vegetation from degradation by wildfire suppression efforts.

a. Avoid the use of earth-moving equipment within national register eligible heritage resource sites, known locations of R2 sensitive species and SOLC plants, BAs, RNAs, or in stream channels, except at designated points and with proper mitigation. Prohibit this use in the Wilderness.

Noxious Weeds

Standard 4303. Develop a noxious-weed management program that addresses the following components: awareness, prevention, inventory, planning, treatment, monitoring, reporting, and management objectives. Control noxious weeds using the following priority order:

a. R2 sensitive and species of local concern occurrences of snails and plants;

b. Research natural areas;

c. Botanical areas;

d. New invaders;

e. New areas of infestation;

f. Spreading or expanding infestations

g. Existing infestations.

Standard 4304. Treat individual plants or groups of plants in areas where R2 sensitive or species of local concern plants occur. Use a treatment method that is the least risk to the species being protected.

Standard 4309. Monitor weed treatments used at R2 sensitive and species of local concern plant occurrences and re-treat as needed during the season.

Recreation
Standard 5213. Do not locate any new developed recreation sites in or immediately adjacent to known locations of R2 sensitive or species of local concern plants.

Management Area 3.1-Botanical Areas
Setting: Botanical management areas or rare natural communities may be located in a number of places throughout the Forest. The environmental conditions in which they exist may differ from each other, such as site-specific climatic conditions, soil types, elevations and precipitation zones; however, the thread common to all of them is that they exhibit plant communities, associations and/or individual species of particular interest

Activities and Opportunities:

Non-motorized Dispersed Recreation	Yes
On-Road Motorized Vehicles	Yes
Off-Road Motorized Vehicles	No, except administrative
Timber Harvesting	Minimal
Livestock Grazing	Yes
Mineral Development	Potential Mineral Withdrawal

Desired Future Condition: Management emphasis is on conserving or enhancing areas of botanical interest and, where appropriate, developing and interpreting these areas for public education.

These areas are protected to maintain their botanical interest values. Botanical areas (BAs) provide protection for threatened, endangered or sensitive species, and other elements of biological diversity, or for their scenic and/or public property values. Botanical areas can vary in size from small sites to fairly large sites.

Botanical areas should be studied to try to identify what factors have led to the area's characteristic habitat. This information can be used to conserve and enhance the area.

A management strategy may be developed for botanical areas.

Vegetation, habitat, soil productivity and water quality are usually unaffected by humans. The setting is usually natural, but varies from site to site. Facilities may be present to the extent needed to maintain the area or to facilitate visitor use of the area. Recreational use of these sites is primarily intended for interpretation and educational activities.

Many of the botanical management areas include various recreation opportunities. In addition to activities of flora observations, interpretation and photography, these areas may provide for such opportunities as fishing, hunting, picnicking, bird watching, and hiking.

Renewable and extractive uses are restricted or prohibited. Livestock grazing is allowed if it does not conflict with the values for which the botanical area was designated. These sites may be closed to public use when needed to protect botanical attributes from disturbances. No new roads are permitted in these areas, and new trails are not constructed, unless they are needed for interpretive or educational purposes or to correct resource damage currently occurring.

Management Area Goals and Objectives

Biological Elements -- Flora

Forest Communities

3.1-201. *Maintain or enhance the botanical features of these areas. Monitor to determine if botanical features are being maintained. **OBJECTIVE**

Management Area Standards and Guidelines

General

3.1-1001. *Protect the unique biological, geological, historical, paleontological, or additional botanical values that may continue to be discovered, along with the botanical values for which the botanical area was designated. No new mineral material permits will be issued for this area. **STANDARD**

Physical Elements

Minerals

3.1-1501. Withdraw this area from mineral entry in conformance with Section 204 of the Federal Land Policy and Management Act of 1976 (PL 94-579) when withdrawal is necessary to protect the values for which the botanical area was designated. **STANDARD**

Biological Elements -- Flora

Forest Communities

3.1-2101. Allow logging and wood gathering activities only when necessary to maintain, restore or enhance values for which the botanical area was designated. **STANDARD**

3.1-2102. Tentatively suitable lands within these areas do not contribute to the allowable sale quantity and are not part of the suitable timber land base. **STANDARD**

Rangeland

3.1-2501. Allow livestock grazing if it does not conflict with the values for which the botanical area was designated. **STANDARD**

3.1-2502. Allow new improvements only when they are necessary to maintain, restore or enhance the values for which the botanical area was designated. **GUIDELINE**

3.1-2503. Restrict access of domestic livestock to protect the R2 sensitive and species of local concern plant occurrences in designated botanical areas. **STANDARD**

Disturbance Processes

Fire and Fuels

3.1-4101. Manage fire and fuels through control practices and prescribed fire to protect the values for which the botanical area was designated. Use minimum impact suppression tactics when suppressing wildfire. **STANDARD**

3.1-4102. Consider opportunities for prescribed natural fire (PNF) and cover under an approved PNF strategy if appropriate. **GUIDELINE**

Social Elements

Recreation

3.1-5101. Allow recreation use with emphasis on interpretation and education when it does not threaten the values for which the botanical area was designated. **STANDARD**

3.1-5102. Protect the area from actual or potential damage due to public use. Utilize closures under 36 CFR 261.53 Subpart B when necessary. **STANDARD**

3.1-5103. The Recreation Opportunity Spectrum (ROS) classes are listed below…

e. Englewood Springs - Semi-primitive Non-motorized.

Scenery Management

3.1-5601. The adopted scenic integrity objectives (SIO) is high. **GUIDELINE**

Administrative Elements

Special Uses

3.1-8501. Allow authorization that protects or enhances the area. **STANDARD**

Transportation and Travel Management

(Exceptions to travel restrictions/prohibitions may be allowed for administrative uses.)

3.1-9101. Travel is restricted to designated routes except for emergency and administrative use. **STANDARD**

3.1-9102. Off-road motorized travel is prohibited except for emergency and administrative use. **STANDARD**

3.1-9103. Over-the-snow motorized travel is restricted to designated routes and areas except for emergency and administrative use. **STANDARD**

3.1-9104. Construct new roads or trails only when they are necessary for interpretive or educational purposes or when they will correct resource damage occurring from existing roads, trails or other uses. Roads may also be constructed if they are needed to maintain, restore or enhance the values for which the botanical area was designated. **STANDARD**

Appendix B: Monitoring Protocols

Englewood Springs Botanical Area
Management Strategy

1 *Listera convallarioides* frequency plots

1.1 Macroplot number, size and placement

Four permanent macroplots 20 m x 20 m square will be established. Macroplots will be located to capture the range of *Listera convallarioides* subpopulations within ESBA. One macroplot will be placed within the core population at the springhead forest opening and the other three will be distributed among other subpopulations scattered on the hillside, and along the toe slope and valley bottom stream.

Macroplot location will be monumented and recorded. Macroplots will be photographed each year using the same methods to allow for comparison.

1.2 Transect placement within macroplot

Ten transects 20 m in length will be placed within each macroplot (for a total of 40 transects) at 2 m intervals beginning at 2 m using a graduated measuring tape. The baseline for transect placement will be the southernmost side of the macroplot.

1.3 Plot size

Initial plot size will be 0.5 m x 0.5 m square. Plot size may need to be adjusted using methods described in Elzinga, Salzer, and Willoughby (1998). Optimum plot size will be determined during the pilot period. In order to maximize sensitivity to a decline in frequency, initial frequency values should be between 50% and 80%.

1.4 Plot placement along transects

Plots will be placed at 2 m intervals along the entire length of each 20 m transect. At establishment, the starting point for plots will be randomly determined in 0.5 m intervals from 0 to 4 m, allowing for 9 possible starting positions. This allows for 10-12 plots per transect, depending on the starting point. Once random placement of plots has been determined, the placement of plots along each transect will be recorded and repeated (i.e., macroplots, transects, and plots will all be permanent and remeasured each year.)

1.5 Reading frequency plots

Listera convallarioides frequency will be determined by the presence of an individual stem within the plot. These typically have a pair of opposite, sessile leaves. Stems must be rooted within the plot or be bisected by the plot boundary to be counted (even if a portion of the leaves is outside the plot). The stem is only touched by the plot boundary, the plant will not be counted.

There are two classes for *Listera convallarioides*: 1) vegetative and 2) reproductive. Plots can be read during a broad time span during the growing season, from bud to fruit. Plants with any

reproductive structure from the current season should be counted as reproductive. Plots with *Lister convallarioides* present are likely to have both vegetative and reproductive stems.

1.6 Sampling objectives, data collection and analysis

For *Listera convallarioides*, the sampling objective is to detect a downward trend of 30% or more in any macroplot with 80% confidence and a false-change error of 15% or less. Plot data will be recorded on data sheets and entered into Excel or into a PDR.

Since macroplots are subjectively placed, they cannot be compared to one another. Data from the same macroplots must be compared from year to year. Data analysis will be performed following techniques outlined in Elzinga, Salzer, and Willoughby (1998). Significance will be determined using McNemar's test. The threshold will be a *P* value of .20 or less. The study design outlined above samples 6% of the macroplot, therefore the finite population correction factor (FPC) needs to be applied to the results of the significance test. A *post hoc* power analysis will be conducted in the event of non-significance.

2 Revegetation canopy cover transects

2.1 Macroplot number, size, and placement of transect baseline

One 10 m x 20 m macroplot will be located in each of two key areas targeted for revegetation: 1) along the lower end of the valley bottom stream where livestock have been crossing, 2) the southern-most primary spring brook above the road cut bank (total macroplots are two).

The macroplots will be positioned approximately centered in the disturbed areas, with the long side of the macroplot parallel to the stream banks. A baseline for transect placement will be located in the center of the macroplot (at the 5 m mark), again running parallel to the stream, with the 0 end starting on the upstream side. For the spring brook, the baseline will likely bisect the area between the two braided stream channels. For the valley bottom stream, with its wider channel, this design will likely result in the baseline bisecting the stream channel. To avoid including a large area of the stream channel in the valley bottom transects, the transects in this area will be set 1 m from the baseline, placing the starting mark approximately where the stream banks should be.

The line intercept cover transects will be reread annually for five years. Monitoring of either macroplot may be discontinued if the 75% target is reached earlier.

2.2 Transect placement along baseline

The transect baseline will be located down the center of the macroplot (as described above). 20 transects spaced one meter apart and 10 m in length will be established from the baseline. The starting point for the transects along the baseline will be 0, 0. 5 m, or 1.0 m but will be selected randomly from the three possible starting positions. Each transect will be placed randomly to the left or right of the base line, determined by flipping a coin. The valley bottom transects will be offset from the baseline by 1 m on the randomly selected side to account for the stream channel. This design may need to be adjusted based on field conditions at the time of transect

establishment. Once properly located, these transects will be fixed for the term of the monitoring.

Each transect will be monumented so that they may be reread annually. Photographs will be taken of each transect and documented so that photographs may be repeated each year.

2.3 Reading line intercept transects

Each 10 m transect will measure herbaceous plant canopy by line intercept using a graduated measuring tape. Canopy cover will be read to the nearest centimeter. Established trees and shrubs will not be counted, only the herb layer, mosses and/or liverworts, or regenerating tree seedlings or shrublings. Noxious weed species will not be counted as canopy cover. A pin will be used to assist the observer in locating the line intercept perpendicular to the transect. Plant canopy cover intersecting the line will be recorded in centimeters by noting the point where the canopy begins and ends along the measuring tape. Gaps of two centimeters or less may be counted as continuous canopy.

Because the amount of cover increases as the growing season progresses, transects must be read at the same phenological stage each year. Transects should be read at a time when average cover is greatest for most species. This is likely to be in July or August.

Repeat photographs of transects will taken each year using the same methods to allow for comparison.

2.4 Sampling objectives, data collection and analysis

The sampling objective is to detect a total plant canopy cover of 75% in any sampling area with 90% confidence. Transect data will be recorded on data sheets and entered into Excel or into a PDR. The sampling unit is each transect.

Since macroplots are subjectively placed, they cannot be compared to one another. Each macroplot area will be evaluated separately for the 75% target. Data analysis will be performed following techniques outlined in Elzinga, Salzer, and Willoughby (1998). Percent cover is determined by the of the measured plant canopy divided by the total transect length.

3 Noxious weed line intercept transects

3.1 Transect establishment, number, size, and placement

A 40 m baseline transect will be set up in three different priority weed treatment areas (identified in “Management Recommendations, Noxious Weeds”). Three transects 30 m in length will be established along the baseline in 10 m increments by selection of a random starting point between 0 and 10. Placement of 30 m transects left and right of the baseline will be determined by flipping a coin. These 30m transects will be monumented and reread annually. Transects will remain for the length of time required to achieve the objective.

3.2 Reading line intercept transects

Each 30 m transect will measure the amount of noxious weed plant canopy by line intercept using a graduated measuring tape. Canopy cover will be read to the nearest centimeter. Noxious weeds counted will be any plant species considered a noxious weed by the Black Hills National Forest at the time the monitoring is performed. A dowel or pin flag will be used to assist the observer in locating the line intercept perpendicular to the transect. Noxious weed plant canopy cover intersecting the line will be recorded in centimeters by noting the point where the canopy begins and ends along the measuring tape. Canopy gaps greater than 5 cm will be counted as separate intercepts; thus gaps less than 5 cm in length will be counted as continuous canopy.

Because the amount of cover increases as the growing season progresses, transects must be read at the same phenological stage each year. Transects should be read at a time when average cover is greatest for most species. This is likely to be in July or August.

Repeat photographs of transects will taken each year using the same methods to allow for comparison.

3.3 Sampling objectives, data collection and analysis

The sampling objective is to detect a decrease of native plant canopy cover of 50% in any sampling area with 90% confidence and a false-change error of 15% or less. Transect data will be recorded on data sheets and entered into Excel or into a PDR.

Since sampling areas are subjectively placed, they cannot be compared to one another. The same areas must be compared from year to year. Data analysis will be performed following techniques outlined in Elzinga, Salzer, and Willoughby (1998). Percent cover is determined by the of the measured noxious weed plant canopy divided by the total transect length. Significance will be determined using a one-tailed *t* test (to detect change in one direction, in this case, an increase in cover). The threshold will be a *P* value of .10 or less. A *post hoc* power analysis will be conducted in the event of non-significance.

4 Pilot study

The protocols described above need to be tested in the field to determine that they measure the desired attribute within desired accuracy and power parameters. Two years of data will be required for trend-based objectives. However, the first year's data and monitoring protocols will be evaluated to the maximum extent possible. Sampling schemes, plot sizes, macroplot design and placement, and line intercept transect placement all need to be evaluated as they are implemented. Any adjustments to the protocol will be documented.

5 Reporting monitoring results

A complete report describing data collection methods, data analysis, results, interpretation, and analysis of management implications will be produced after year 2 of implementation and annually

thereafter. This report may be stand-alone or may be incorporated into the Black Hills National Forest annual Monitoring and Evaluation Reports.